NASA CR-
WRL-31650-24-T

CR-115757

THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION

by
Virginia Leeman
Dianne Earing
Robert K. Vincent
Sharon Ladd

INFRARED AND OPTICS LABORATORY
WILLOW RUN LABORATORIES
INSTITUTE OF SCIENCE AND TECHNOLOGY
THE UNIVERSITY OF MICHIGAN

prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA Manned Spacecraft Center
Contract NAS 9-9784
W. E. Hensley/TD, Project Manager

(NASA-CR-115757) THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION V. Leeman, et al (Michigan Univ.) May 1971 [redacted] p CSCL 08G

N72-28366
Unclas
G3/13 36922

475

NOTICES

Sponsorship. The work reported herein was conducted by the Willow Run Laboratories of the Institute of Science and Technology for the National Aeronautics and Space administration under NASA Contract NAS 9-9784 with Mr. W. E. Hensley/TD, Earth Resources Office, as Project Manager. Contracts and grants to The University of Michigan for the support of sponsored research are administered through the Office of the Vice-President for Research.

Disclaimers. This report was prepared as an account of Government-sponsored work. Neither the United States, nor the National Aeronautics and Space Administration (NASA), nor any person acting on behalf of NASA:

(A) Makes any warranty or representation, expressed or implied with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or

(B) Assumes any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

As used above, "person acting on behalf of NASA" includes any employee or contractor of NASA, or employee of such contractor, to the extent that such employee or contractor of NASA or employee of such contractor prepares, disseminates, or provides access to any information pursuant to his employment or contract with NASA, or his employment with such contractor.

Availability Notice. Requests for copies of this report should be referred to:

National Aeronautics and Space Administration
Scientific and Technical Information Facility
P. O. Box 33
College Park, Md. 20740

Final Disposition. After this document has served its purpose, it may be destroyed. Please do not return it to the Willow Run Laboratories.

NASA CR-
WRL 31650-24-T

TECHNICAL REPORT

THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION

by
Virginia Leeman
Dianne Earing
Robert K. Vincent
Sharon Ladd

INFRARED AND OPTICS LABORATORY
WILLOW RUN LABORATORIES
INSTITUTE OF SCIENCE AND TECHNOLOGY
THE UNIVERSITY OF MICHIGAN

prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

May 1971

CONTRACT NAS 9-9784

NASA Manned Spacecraft Center
Houston, Texas 77058
W. E. Hensley/TD, Project Manager
Earth Resources Office

FOREWORD

This report describes part of a comprehensive and continuing program of research into remote sensing of the environment from aircraft and satellites. The research is being carried out by the Willow Run Laboratories, a unit of The University of Michigan's Institute of Science and Technology, for the NASA Manned Spacecraft Center, Houston, Texas. The basic objective of this multidisciplinary program is to develop remote sensing as a practical tool to provide the planner and decision-maker with extensive information quickly and economically.

Timely information from remote sensing will be important to such people as the farmer, the city planner, the conservationist, and others concerned with a variety of problems such as crop yield and disease, urban land studies and development, water pollution, and forest management. The scope of our program includes: (1) extending understanding of basic processes; (2) developing new applications, advanced remote sensing systems, and automatic data processing to extract information in a useful form; and (3) assisting in data collection, processing, and analysis, including material spectra and ground-truth verification.

The research described here was performed under NASA Contract NAS 9-9784, Task B3, and covers the period from October 1969 through September 1970. The program was directed by M. R. Holter, formerly Head of the Infrared and Optics Laboratory, and is now being directed by R. R. Legault, Associate Director. The work was done under the management of the NASA Contract Monitor, W. E. Hensley/TD, Manned Spacecraft Center. The Willow Run Laboratories' number for this report is 31650-24-T. Appendix II contains a list of related reports.

ABSTRACT

This report describes the NASA Earth Resources Spectral Information System (ERSIS) and the information contained therein. It contains an ordered, indexed compilation of natural targets in the optical region from 0.3 to 45.0 μm.

The data compilation includes approximately 100 rock and mineral, 2600 vegetation, 1000 soil, and 60 water spectral reflectance, transmittance, and emittance curves. Most of the data have been categorized by subject, and the curves in those subject areas have been plotted on a single graph. Those categories with too few curves and miscellaneous categories have been plotted as single-curve graphs. Each graph, composite of single, is fully titled to indicate curve source and is indexed by subject to facilitate user retrieval.

Preceding page blank

CONTENTS

Preceding page blank

FIGURES

TABLES

THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION

SUMMARY

This report summarizes the NASA Earth Resources Spectral Information System (ERSIS) and the information contained therein. It contains an ordered, indexed compilation of data useful for improving remote sensing techniques.

The data compilation includes approximately 100 rock and mineral, 2600 vegetation, 1000 soils, and 60 water spectral reflectance (transmittance, emittance) curves in the optical region from 0.3 to 45.0 μm.* Most of the data have been categorized by subject, and the curves in those subject areas have been plotted on a single graph. Those categories with too few curves and miscellaneous categories have been plotted as single-curve graphs. Each graph, composite or single, is fully titled to indicate curve source and is indexed by subject to facilitate user retrieval. In addition, the documents from which the curves have been extracted are summarized to facilitate the use of the data. Information on the experimental platform, instrumentation, reflectance standards (for relative data), and other related matters has been included, and additional references describing some of the instrumentation in greater detail are cited.

All of the data included in this publication are available in digital form at NASA/MSC as part of ERSIS. The present computer facility includes a set of magnetic tapes containing the optical, spectral data and a series of computer programs for updating the magnetic tapes, for retrieving data from the tapes, and for analyzing the retrieved data.

*The majority of the curves in this report were obtained from the Target Signatures Analysis Center (TSAC) Library, developed at The University of Michigan for the U. S. Air Force under Air Force Contract AF 33(657)-10974 and were previously reported in Ref [1].

1
INTRODUCTION

Prior knowledge of the spectral signatures of potential targets is of great value to planners of remote sensing missions; such knowledge permits the experimenter to choose the optimum detection system for discriminating the targets of interest in an economical and timely manner. The concept of the NASA Earth Resources Spectral Information System (ERSIS) is to provide the spectral signatures of natural targets to scientists in the remote sensing community in a catalogue form which is quick and simple to use. Our efforts to consolidate this information should not be viewed as an attempt to enter agricultural, geological, or other remote sensing fields, but rather as an attempt to serve these various fields as a catalyst for stimulating researchers in these fields to evaluate and become more deeply involved in the use of spectral signatures for analysis of remote sensing applications. We hope they will view this ERSIS activity as theirs to participate in rather than ours provided for them. This report describes the ERSIS and the information contained therein; it is one of four reports pertaining to the system. The other three reports are "Earth Resources Spectral Information System Procedures Manual" which explains the data information-retrieval procedures, "Data Gaps in the NASA Earth Resources Spectral Information System" which delineates the experimental data needed most to improve this catalogue, and "Remote Sensing Data-Analysis Projects Associated with the NASA Earth Resources Spectral Information System" which demonstrates the usefulness of the ERSIS by showing how analysis of remote sensing problems has been aided by information in the system.

The Earth Resources Spectral Information System established at NASA/MSC and maintained by The University of Michigan consists of a set of magnetic tapes containing optical, spectral data and a series of computer programs for updating these magnetic tapes, for retrieving data from the tapes, and for analyzing the retrieved data. It provides a centralized source of data useful for improving remote sensing techniques. Sources for the data are reports published by laboratories making such measurements and unpublished data acquired directly from an experimenter. Each report is examined for data to be added to the system.

Selected curves are then manually digitized with an established format. Great care is exercised to preserve all significant details of the original curve except those details attributable to instrument noise. Data points are taken in such a way that the new curve formed by connecting the data points with straight lines will duplicate the original curve. The curves are then given an identification number, defined in Section I, of Appendix I, and coded with subject descriptors that describe the material and/or object measured and the complete conditions of the experiment. These descriptors provide the basis for retrieval. The current NASA/MSC Earth Resources Spectral Information System includes approximately 100 rock and mineral, 2600 vegetation, 1000 soil, and 60 water, spectral reflectance, transmittance, and emittance curves (or data sets).

Three kinds of measurements are represented: (1) laboratory measurements of materials, such as leaves, rocks, and soil; (2) ground-based field measurements of objects, such as plants and soil plots; and (3) a few uncorrected airborne measurements of scenes in a special category. In the optical portion of the spectrum, laboratory-measurement programs are far more abundant than either ground-based field measurements or airborne-measurement programs.

Separate, master magnetic tapes are kept for soil and water, vegetation, and rock and mineral spectra. The present retrieval system allows for the specification of any of a group of coded descriptors, specified experimental conditions, or individual curve identification numbers. Interpolation of the digitized data points to find the reflectance (transmittance, emittance) at a particular wavelength is also performed. In addition, mean values, standard deviations, and maximum-minimum envelopes of the digitized curves may be routinely computed for a retrieved subset of data. Microfilm plotting programs and punched, card-deck output for scientists' utility programs will soon be in use. The "Earth Resources Spectral Information Procedures Manual," mentioned earlier, describes the organization of the data on the master tape, input specifications for retrieval-analysis programs, and actual operating instructions for the Univac 1108 computer located at the Manned Spacecraft Center in Houston, Texas.

Each data curve has been assigned alphabetic and/or numerical descriptor codes to describe the object measured. A list of these codes is given in Section 2. The data curves in this publication have been grouped according to the coded descriptor that best describes the object measurement. This prime descriptor, a page number, and the common names of the objects are arranged as a cross index in Section 3.

Section 4 contains the plots of actual, directional reflectance (transmittance, emittance) curves. Section 4.1 contains composite plots of several, vegetation categories, such as crops, grasses, and trees. The categories are roughly those of the "Supplement to Vegetation Subject Codes" (See Section 2). In some cases, a further division was made to point out the effects of variations in the following: moisture and fertilizer content, background of the material, mode of measurement, and age of the sample or time after picking. Additional explanations detail the chlorophyll, water, and cellulose bands, which are prominent features in the vegetation spectra.

Section 4.2 contains single plots or rocks, minerals, soils, water, and miscellaneous vegetation data not included in the composite plots in Section 4.1. Included with each plot, composite or single, is a title listing of the material(s) measured plus the document and curve numbers, thus completely identifying the curve source.

Appendix I of this report discusses (1) a theoretical treatment of reflectance, (2) instrumentation used to collect the data, (3) absolute reflectance, and (4) the documents from which data were obtained.

2
LIST OF SUBJECT CODES

Those agency investigators and scientists interested in using the ERSIS probably will have useful suggestions for improving the classification schemes and subject codes, and these will be welcome. As more data is added to the ERSIS, more detailed breakdowns and codes will be required.

2.1. VEGETATION SUBJECT CODES

The alphabetic vegetation subject codes, classified according to biological families, are listed in Table 1. In Table 2, entitled Supplement to Vegetation Subject Codes, the vegetation spectra are classified with alpha-numeric codes according to layman nomenclature for the plant families. Every vegetation curve has been classified with two subject codes, one for the biological names, and one for the common name. From these two tables, one can select curves of individual species or of entire plant families. The numbers shown in parentheses correspond to the number of spectra for each category. Numbers adjacent to the major, subject-code categories indicate how many curves are included that do not fit into any of the subcategories under that major subject code.

2.2. ROCK AND MINERAL SUBJECT CODES

Table 3 lists the rock and mineral subject codes (alpha-numeric) classified according to rock and mineral composition. The codes are as detailed as possible from the identifications reported. This results in some uneveness in the classification scheme. The silicate rocks are arranged approximately according to SiO_2 content. Each number in parentheses relates how many curves of each subcategory are contained in ERSIS.

2.3. SOIL AND WATER SUBJECT CODES

Table 4 contains a list of alphabetic soil and water subject codes. The soils are classified according to texture and soil series, whereas the water spectra are arranged according to macroscopic formation and physical state. The parenthetical numbers correspond to the number of spectra for each category.

2.4. PARAMETER SUBJECT CODES

Finally,Table 5 denotes the alphabetic subject codes used as parameter information. These codes describe the experimental conditions of the measurements.

TABLE 1. VEGETATION SUBJECT CODES. (Classified according to families in a biological sense, i.e., Mustard family)

BG	Vegetation (31)
BGA	Herbaceous, Algea Fungi
BGAA	Cladoniaceae Family
BGAAA	Reindeer Moss (1)
BGB	Moss-Liverwort (3)
BGBA	Sphagnum Family
BGBAA	Sphagnum Moss (3)
BGC	Vascular (13)
BGCA	Banana Family (2)
BGCAA	Banana
BGCB	Bromeliaceae Family
BGCBA	Bunch Grass
BGCC	Buckwheat Family
BGCCA	Buckwheat (1)
BGCD	Composite Family (4) (cf. Ligneous)
BGCDA	Daisy (3)
BGCDB	Goldenrod
BGCDC	Ragweed (1)
BGCDD	Sunflower (1)
BGCE	Convolvulus Family
BGCEA	Sweet Potato (1)
BGCF	Crowfoot Family
BGCFA	Crowfoot (3)
BGCG	Duckweed Family
BGCGA	Duckweed (2)
BGCH	Evening-Primrose Family
BGCHA	Willow Herb (cf. Willow Family)
BGCI	Fern Family (3)
BGCIA	Bracken Fern (1)
BGCJ	Flax Family
BGCJA	Flax (5)
BGCK	Goosefoot Family (3)
BGCKA	Pigweed (3)
BGCKB	Sugar Beet (9)
BGCL	Gourd Family
BGCLA	Squash (3)
BGCM	Grass Family (148)
BGCMA	Barley (15)
BGCMB	Bermuda Grass
BGCMC	Corn (188)
BGCMD	Creeping Grass (1)
BGCME	Fescue (3)
BGCMF	Foxtail (6)
BGCMG	Ilyas (13)
BGCMH	Millet (4)
BGCMI	Oats (15)
BGCMJ	Reeds (1)
BGCMK	Rice (5)
BGCML	Rye (7)
BGCMM	Selin (1)
BGCMN	Timothy (9)
BGCMO	Vetch (1)
BGCMP	Wheat (130)
BGCN	Heath Family (5) (see also Ligneous)
BGCNA	European Blueberry
BGCNB	Heather (1)
BGCO	Mallow Family (5)
BGCOA	Cotton (94)
BGCP	Mustard Family
BGCPA	Cabbage (5)
BGCPB	Mustard (1)
BGCQ	Nightshade Family
BGCQA	Potatoes (4)
BGCQB	Tomatoes (5)
BGCR	Pea (or Pulse) Family (3) (see also Ligneous)
BGCRA	Alfalfa (32)
BGCRB	Clover (14)
BGCRC	Coffee Plant (1)
BGCRD	Lentil (2)
BGCRE	Lima Bean (3)
BGCRF	Pea (1)
BGCRG	Peanut (9)
BGCRH	Soybean (160)
BGCRI	String Bean (4)
BGCS	Plantain Family
BGCSA	Plantain (2)
BGCT	Sedge Family (1)
BGCTA	Cotton Grass (1)
BGCTB	Sedge (5)
BGD	Ligneous (26)
BGDA	Arecaceae Family (7)
BGDAA	Areca Palm (1)
BGDB	Beech Family
BGDBA	Beech (24)
BGDBB	Chestnut (2)
BGDBC	Oak (162)
BGDC	Bignonia Family
BGDCA	Catalpa (12)
BGDD	Dalycanthacea Family
BGDDA	Meratia Praecox (2)
BGDE	Carduacea Family
BGDEA	Rabbit Brush (1)
BGDF	Cashew Family
BGDFA	Chinese Pistachio (1)
BGDFB	Sumac (2)
BGDG	Composite Family (1) (cf. Herbaceous)
BGDGA	Sagebrush (3)
BGDGB	Wormwood (3)
BGDH	Dogwood Family (35)
BGDHA	Dogwood
BGDI	Ebony Family

TABLE 1. VEGETATION SUBJECT CODES. (Classified according to families in a biological sense, i.e., Mustard family (Continued)

BGDIA	Ironwood (2) (cf. Hazel Family)
BGDIB	Persimmon (2)
BGDJ	Elm Family
BGDJA	Elm (22)
BGDK	Figwort Family (4)
BGDKA	Paulowina (1)
BGDL	Hazel Family
BGDLA	Alder (1)
BGDLB	Birch (23)
BGDLC	Hazelnut (6)
BGDLD	Hornbeam (1)
BGDLE	Ironwood (cf. Ebony Family)
BGDM	Heath Family (12) (cf. Herbaceous)
BGDMA	Mountain Laurel (3)
BGDN	Holly Family
BGDNA	Holly (3)
BGDO	Honeysuckle Family (2)
BGDOA	Viburnum
BGDP	Laurel Family (5)
BGDPA	Laurel (2)
BGDPB	Sassafrass (3)
BGDQ	Lily Family
BGDQA	Yucca (1)
BGDR	Linden Family
BGDRA	Basswood (54)
BGDRB	Linden (3)
BGDS	Logania Family
BGDSA	Privet (2) (Ligustrum)
BGDT	Magnolia Family (2)
BGDTA	Magnolia (2)
BGDTB	Tulip (3)
BGDTC	Tulip Poplar (5)
BGDU	Maple Family (168)
BGDUA	Maple
BGDV	Mulberry Family (2)
BGDVA	Rubber (10)
BGDW	Olive Family (7)
BGDWA	Ash (58)
BGDX	Pine Family (3)
BGDXA	Cedar (8)
BGDXB	Fir (10)
BGDXC	Juniper (6)
BGDXD	Larch (4)
BGDXE	Pine (286)
BGDXF	Spruce (11)
BGDY	Plane-Tree Family
BGDYA	Sycamore (151)
BGDZ	Pea Family (5) (cf. Herbaceous)
BGDAZ	Locust (5)
BGE	Ligneous (continued)
BGEA	Rose Family (18)
BGEAA	Blackberry (1)
BGEAB	Cherry (9)
BGEAC	Hawthorn (1)
BGEAD	Juneberry (3)
BGEAE	Peach (10)
BGEAF	Pin Cherry (1)
BGEAG	Plum (11)
BGEB	Sour Gum Family (2)
BGEBA	Gum
BGEC	Trumpet-Creeper Family
BGECA	Calabash (4)
BGED	Vine Family
BGEDA	Virginia Creeper
BGEE	Walnut Family (1)
BGEEA	Hickory (6)
BGEF	Willow Family (98)
BGEFA	Aspen (36)
BGEFB	Poplar (116)
BGEFC	Willow (5) (cf. Evening Primrose Family)
BGEFCA	Dwarf (1)
BGEFCB	Ground (50)
BGEG	Witch Hazel Family
BGEGA	Sweet Gum
BGF	Leaf (128)
BGFA	Narrow (490)
BGTB	Broad (202)
BGFBA	Coriaceous (Leathery)
BGFBB	Membranous
BGFBC	Lower Leaf Surface (285)
BGFBD	Upper Leaf Surface (565)
BGFC	Young (Spring) (25)
BGFD	Mature (Summer) (67)
BGFE	Old (Fall) (49)
BGFF	Dry (163)
BGG	Bark (38)
BGH	Twig (22)

TABLE 2. SUPPLEMENT TO VEGETATION SUBJECT CODES (Classified according to families in a layman, user-oriented sense, i.e., Corps)

- 40 Herbs (2)
  - 41 Crops (2)
    - 41A Vegetables (49)
      - 41A1 Soybeans (11)
        - 41A1A Soybean leaf, green (48)
        - 41A1B Soybean pods and stems (46)
        - 41A1C Soybean leaf, mature (11)
        - 41A1D Soybeans, flowering (30)
        - 41A1E Soybeans, seedling stage (12)
    - 41B Grains (Misc.)
      - 41B1 Barley (9)
        - 41B1A Barley field, stubble (6)
      - 41B2 Corn (23)
        - 41B2A Corn leaf, green (47)
        - 41B2B Corn leaf, brown (44)
        - 41B2C Corn leaf, yellow (15)
        - 41B2D Corn tassel (12)
        - 41B2E Corn, normal stand (20)
        - 41B2F Corn kernel (6)
        - 41B2G Corn, multicolored leaves (21)
      - 41B3 Oats (6)
        - 41B3A Oats field, stubble (9)
      - 41B4 Sorghum leaf, green (22)
        - 41B4A Sorghum, brown (15)
      - 41B5 Wheat (28)
        - 41B5A Wheat field, normal stand (36)
        - 41B5B Wheat field, thin stand (30)
        - 41B5C Wheat, diseased (13)
        - 41B5D Wheat heads (6)
        - 41B5E Wheat, seedling stage (20)
    - 41C Clothing fibers (5)
      - 41C1 Cotton (94)
  - 42 Nonflowering plants and weeds (41)
    - 42A Grass (42)
      - 42A1 Diseased grass (10)
      - 42A2 Brown grass (59)
    - 42B Ilyas (13)
  - 43 Flowering plants (28)
    - 43A Alfalfa (32)
  - 44 Flowering weeds (21)
    - 44A Clover (21)
- 50 Shrubs (36)
  - 51 Dogwood (35)
- 60 Trees (4)
  - 61 Deciduous (79)
    - 61A Nut trees
      - 61A1 Hickory leaf (5)
      - 61A2 Hazelnut leaf (6)
      - 61A3 Nutree bark (2)
      - 61A4 Chestnut leaf (2)
    - 61B Fruit trees
      - 61B1 Plum fruit (3)
        - 61B1A Plum leaf (7)
        - 61B1B Plum, bark and twig (5)
    - 61C Ash (58)
    - 61D Aspen (36)
    - 61E Basswood (54)
    - 61F Beech (24)
    - 61G Birch (23)
    - 61H Catalpa (12)
    - 61I Elm (22)
    - 61J Maple (50)
      - 61J1 Silver Maple (100)
      - 61J2 Red Maple (30)
    - 61K Oak (50)
      - 61K1 White Oak (50)
      - 61K2 Black Oak (30)
      - 61K3 Burr Oak (30)
    - 61L Poplar (20)
      - 61L1 Cottonwood (100)
    - 61M Sweet Gum (50)
    - 61N Sycamore (151)
    - 61O Tulip Tree (or Yellow or Tulip Poplar) (110)
    - 61P Willows (8)
  - 62 Coniferous (28)
    - 62A Pine (28)
      - 62A1 Red (or Norway) Pine (190)
      - 62A2 Scotch Pine (70)
    - 62B Spruce (10)
      - 62B1 Spruce bark (1)

TABLE 3. ROCKS AND MINERAL SUBJECT CODES (Classified according to rock and mineral mineral composition)

100 Igneous Rocks
- 101 Acidic (greater than 65% SiO_2) Silicate Rocks
  - 101B Obsidian (1)
  - 101C Frothy Pumice (1)
  - 101D Welded Tuff (1)
  - 101E Tektite (1)
  - 101F Quartz Monzonite Porphyry (1)
  - 101G Dacite (1)
  - 101H Granite (1)
  - 101I Graphic Granite (1)
  - 101J Granite Aplite (1)
  - 101K Pyroxene Aplite (1)
  - 101L Rhyolite Pumice (1)
  - 101M Granite Gneiss (1)
  - 101N Trachyte (1)
  - 101P Potash Granite (1)
  - 101Q Migmatite (2)
  - 101R Adamellite (9)
  - 101S Granite Pediment (1)
  - 101T Felsite (1)
- 102 Intermediate (53 to 65% SiO_2) Silicate Rocks
  - 102A Quartz Syenite (1)
  - 102B Andesite (1)
  - 102C Nepheline Syenite (1)
  - 102D Quartz Basalt (1)
  - 102E Hypersthene Andesite (1)
  - 102F Hypersthene Andesite Vitrophyre (1)
  - 102G Quartz Diorite (1)
  - 102H Augitediorite (1)
  - 102I Latite (Squirrel Gulch) (4)
  - 102J Latite (Bonanza) (11)
  - 102K Latite (Eagle Gulch) (2)
  - 102L Biotite Andesite Flow (8)
  - 102M Andesite (Rawley) (11)
  - 102N Latite (Brewer Creek) (8)
- 103 Basic and Ultrabasic (less than 53% SiO_2) Silicate Rocks
  - 103A Garnet Gabbro (1)
  - 103B Augite Gabbro (1)
  - 103C Schist (1)
  - 103D Diabase (1)
  - 103E Basalt (1)
  - 103F Plagioclase Basalt (1)
  - 103G Monchiquite (1)
  - 103H Hornblende Gabbrogneiss (1)
  - 103I Peridotite (1)
  - 103J Olivine Gabbro (1)
  - 103K Nepheline Basalt (1)
  - 103L Serpentine (1)
  - 103M Linburgite (1)
  - 103N Dunite (8)
  - 103P Lava (1)
  - 103Q Gabbro (1)
  - 103R Hornblend Gneiss (2)

110 Sedimentary and Metamorphic Rocks
- 111 Silicate Sedimentary and Metamorphic Rocks
  - 111A Light Colored Sandy Rock (6)
  - 111B Yellow Sandstone Clay (1)
  - 111C Sandy Rock (1)
  - 111D Yellow Sandstone (1)
  - 111E Red Sandstone (1)
  - 111F Shale (1)
  - 111G Grey Sandstone (1)
  - 111H Siltstone (1)
  - 111J Chert (1)
  - 111K Quartzite (1)
- 112 Carbonate Sedimentary and Metamorphic Rocks
  - 112A Limestone (1)
  - 112B Dry White Coral (1)
  - 112C Limestone (Manitou) (1)
  - 112D Marble (1)

120 Minerals
- 121 Silicate Minerals
  - 121A Quartz (3)
  - 121B K-Feldspar (1)
  - 121C Grey Feldspar (1)
- 122 Ferromagnesian Minerals
- 123 Accessory Minerals (6)
  - 123A Carbonate Minerals
    - 123A1 Calcium-Magnesium Carbonate (Dolomite) (1)
    - 123A2 Magnesium Carbonate (Magnesite) (1)
    - 123A3 Calcium Carbonate (1)
    - 123A4 Sodium Carbonate (1)
  - 123B Sulfate and Sulfite Minerals
    - 123B1 Anhydrite Sand (3)
    - 123B2 Calcium Sulfate (1)
  - 123C Nitrate and Nitrite Minerals
    - 123C1 Sodium Nitrate (1)
    - 123C2 Potassium Nitrate (1)
  - 123D Phosphate Minerals
  - 123E Carbonaceous Minerals
    - 123E1 Silicon Carbide (4)
    - 123E2 Graphite (1)

130 Ores and Hydrothermally Altered Rock (1)
- 131 Ores (2)

TABLE 3. ROCKS AND MINERAL SUBJECT CODES (Classified according to rock and mineral mineral composition) (Continued)

131A Uranium Ore (1)	140 Meteorites
132 Hydrothermally Altered Rock	141 Chondrites
132A Latite (Hydrothermally Altered) (2)	141A Leedy (2)
	141B Farmington (2)

TABLE 4. SOIL AND WATER SUBJECT CODES (Classified according to texture and series)

BE	Terrain Uniformity (210)
BEA	Flat (21)
BEB	Rolling
BEC	Hilly (4)
BED	Mountainous (38)
BEE	Rural (127)
BEF	Urban
BF	Soil (77)
BFA	Cultivated (27)
BFB	Uncultivated
BFC	Coarse Textured
BFCA	Sand (61)
BFCB	Loamy Sand (4)
BFD	Moderately Coarse Textured (1)
BFDA	Sandy Loam (35)
BFDB	Fine Sandy Loam (22)
BFE	Medium Textured
BFEA	Loam (33)
BFEB	Silt Loam (31)
BFEC	Silt (1)
BFF	Moderately Fine Textured
BFFA	Clay Loam (30)
BFFB	Sandy Clay Loam
BFFC	Silty Clay Loam
BFG	Fine Textured
BFGA	Sandy Clay
BFGB	Silty Clay
BFGC	Clay (21)
BFH	Other Constituents (4)
BFHA	Organic Material (11)
BFHB	Gravel (less than 3-in. diameter) (9)
BFHC	Cobbles (3- to 10-in. diameter) (6)
BFHD	Stones (greater than 10-in. diameter) (9)
BFHF	Salt
BFI	Series
BFIA	Aguan (4)
BFIB	Aiken (4)
BFIC	Akron (2)
BFID	Alamance (2)
BFIE	Albion (2)
BFIF	Alonso (4)
BFIG	Barnes (3)
BFIH	Blakely (6)
BFII	Clareville (2)
BFIJ	Clarion (4)
BFIK	Collington (1)
BFIL	Colts Neck (11)
BFIM	Decatur (2)
BFIN	Dublin (3)
BFIO	Gooch (3)
BFIP	Grady (3)
BFIQ	Greenville (6)
BFIR	Guthrie (2)
BFIS	Hainamanu (1)
BFIT	Hall (2)
BFIU	Hamakua (2)
BFIV	Herradura (4)
BFIW	Joplin (2)
BFIX	Marias (2)
BFIY	Marshall (2)
BFIZ	Matanzas (2)
BFJ	Series (Continued)
BFJA	Maury (3)
BFJB	Moaula (6)
BFJC	Naalehu (6)
BFJD	Onomea (2)
BFJE	Ookala (4)
BFJF	Orangeburg (4)
BFJG	Oriente (2)
BFJH	Orman (2)
BFJI	Pallman
BFJJ	Penn (2)
BFJK	Pierre (2)
BFJL	Putnam (2)
BFJM	Quibdo (2)
BFJN	Rubicon (2)
BFJO	Ruston (10)
BFJP	Santa Barbara (6)
BFJQ	Texas Dune (4)
BFJR	Tifton (2)
BFJS	Tillman (2)
BFJT	Tilsit (2)
BFJU	Vernon (2)
BFJV	Weld (4)
BFJW	Windthorst (6)

TABLE 4. SOIL AND WATER SUBJECT CODES (Classified according to texture and series) (Continued)

BFJX	Yolo
BFJY	Zanesville (4)
BFK	Minerals (11)
BFL	Chemicals (13)
BH	Water (2)
BHA	Formations (2)
BHAA	Lake (6)
BHAB	Puddle
BHAC	River (3)
BHAD	Sea (12)
BHB	State
BHBA	Ice
BHBB	Ice and Liquid
BHBC	Liquid (8)
BHBD	Snow (30)

Secondary Characteristics Codes (These codes appear occasionally with chemicals, soils, terrain, and water subject codes)

AAG	Roads
AEA	Aluminum
AEH	Dirt
AEJ	Glass
AEK	Gravel
AEL	Metal
AEQ	Tar

TABLE 5. SUBJECT CODES USED AS PARAMETER INFORMATION (Equipment and radiation)

C	Equipment
CA	Radar
CAA	Coherent
CAB	Noncoherent
CAC	Pulse
CAD	CW
CAE	MTI
CAF	Resolution Limited by Antenna
CAG	Synthetic Aperture
CB	Radiometer
CBA	Optical (wavelength less than 1000 μm)
CBB	Microwave Wavelength greater than or equal to 1000 μm)
CBBA	Unmodulated
CBBB	Post-Detection Modulated
CBBC	Signal Modulated
CBBD	Cross Correlated
CBBE	Two-Channel Subtraction
CC	Spectrograph
CCA	Eastman Kodak
CD	Spectrometer
CDA	Beckman
CDAA	Model DU
CDAB	Model DK-1
CDAC	Model DK-2
CDAD	Microspec
CDB	General Electric
CDC	Perkin-Elmer
CDCA	Model 12
CDCB	Model 21
CDD	Interference
CDE	Cary
CDEA	Model 14
CDEB	Model 90
CE	Platform
CEA	Aircraft
CEB	Balloon
CEC	Ground
CED	Laboratory
CEE	Shipborne
CF	Optical
CFA	Ultraviolet
CFB	Visible
CFC	Infrared
CFD	Active
CFE	Passive
CG	Detectors
CH	Filters
CI	Image Tubes
CJ	Materials
CJA	Reflectance Standards (Optical)
CJAA	Magnesium Oxide
CJAAA	Smoked
CJAAB	Pressed
CJAB	Magnesium Carbonate
CJAC	Sulphur
CJAD	Aluminum
CJADA	Mirror
CJABD	Sandblasted
CJAE	Sapphire Felt
CJAF	Other Specular Standards
CJAG	Other Diffuse Standards
CJB	Reflectance Standards (Microwave)
CJBA	Metallic Sphere
CJBB	Luneberg Reflector
CJBC	Corner Reflector
CK	Evaluation
CKA	Noise

TABLE 5. SUBJECT CODES USED AS PARAMETER INFORMATION (Equipment and radiation) (Continued)

CL	Reflectometer (Bidirectional)
CLA	EGR
CLB	PGR
CM	Polarimeter
DD	Polarization
DDA	Radar
DDAA	Circular
DDAAA	Right
DDAAB	Left
DDAB	Elliptic
DDABA	Right
DDABB	Left
DDAC	Linear
DDACA	Horizontal or Perpendicular
DDACB	Vertical or Parallel
DDACC	Oblique
DDACCA	Cross-Polarized
DDACCB	Parallel-Polarized
DDAD	Random
DDB	Optical
DDBA	Circular
DDBAA	Right
DDBAB	Left
DDBB	Elliptic
DDBBA	Right
DDBBB	Left
DDBC	Linear
DDBCA	Perpendicular
DDBCB	Parallel
DDBD	Random
DK	Artificial Sources
DKA	Arc
DKB	Beacon
DKC	Flame
DKD	Flare
DKE	Gas
DKF	Gas Discharge
DKG	Globar
DKH	Incandescent Lamp
DKI	Maser, Laser, Iraser, Uvaser
DKJ	Mantle
DKK	Nernst Glower
DKL	Nuclear Explosion
DKM	Oscillator
DKN	Shock Tube
DKO	Spark
DKP	Vapor Lamp
DKQ	Monochromator
DKR	Blackbody Cavity
DL	Natural Sources
DLA	Aurora
DLB	Airglow
DLC	Lightning
DLD	Lunar
DLE	Planetary
DLF	Solar
DLG	Stellar
DLH	Zodiacal Light
DLI	Sky
DM	Flux
DN	Radiance
DO	Coherence
DP	Diffraction
DQ	Apparent Temperature
DQA	Antenna
DQB	Target
DQC	Contrast
DR	Blackbody Cavity Source
ECBB	Color (used as secondary descriptors)
ECBBA	Blue
ECBBB	Green
ECBBC	Yellow
ECBBD	Orange
ECBBE	Red
ECBBF	Brown
ECBBG	Field Drab
ECBBH	Khaki
ECBBI	Olive Drab
ECBBJ	White
ECBBK	Grey
ECBBL	Black

3
SUBJECT CROSS REFERENCE

The data curves published in this report have been grouped by their primary, subject-descriptor code. A complete list of the subject codes may be found in Section 2. To facilitate use of the data, a cross-reference by the common name of the material has been published in this section. The cross-reference has been divided into 5 main categories which are rocks and minerals, soils, terrain, water, and vegetation. Although the laboratory and field data have been separated, they are cross-referenced together, so that in one place, one can find all of the available data on that subject. To distinguish field from laboratory measurements, an (F) precedes the page number of the field data.

For example, if one desired all the data on potatoes, he would look under Vegetation for Potatoes and find:

Potatoes . . . . BGC 8, 9
(F)BGC 17

He would then proceed to the published data on vegetation and scan the dividers for subject code section BGC. The pages of data will be numbered for example, BGC 1, BGC 2. One follows the same procedure for the field data except that the subject code section would be (F)BGC.

Rocks and Minerals

Soils

4
DATA PLOTS

This section contains a summary of the information contained in the NASA ERSIS. Most of the data have been categorized by subject, and the curves in those categories are plotted on a single graph in the form of a composite plot. However, the rock, mineral, soil, and water data were not plotted as composites because there were too few curves per category. These and some of the miscellaneous vegetation curves were plotted as single curve graphs.

The method of presenting the data as composite plots has two advantages for remote sensing applications. It quickly informs the user of the amount of data available in that category and illustrates the variability of data within the category. Knowledge of the source of this variability is important remote sensing applications. In many cases, spectra in a given category may have been obtained by several different experimenters under a variety of conditions and direct comparison of these data is misleading. There are four major sources of variability of primary concern. First, the environmental conditions may vary greatly among data sets. The best examples of this are the environmental differences between laboratory and field data and the sporadic natural contamination of sample surfaces by dust and water. Second, the instrumentation and experimental setup can vary considerably among measurement programs, i.e., a set of spectra may be bidirectional (directions of sample illumination and observation confined to small solid angles) or hemispherical (solid angle of observation of 2π sr) reflectance measurements. To circumvent some of the environmental and instrumentation variability, separate, composite plots from documents B-01643 (USAERDL Field Data) and B-03995 (Krinov Field Data) have been prepared because they represent measurements made under different experimental conditions from the rest of the data. (See Appendix I for a discussion of measurement techniques.)

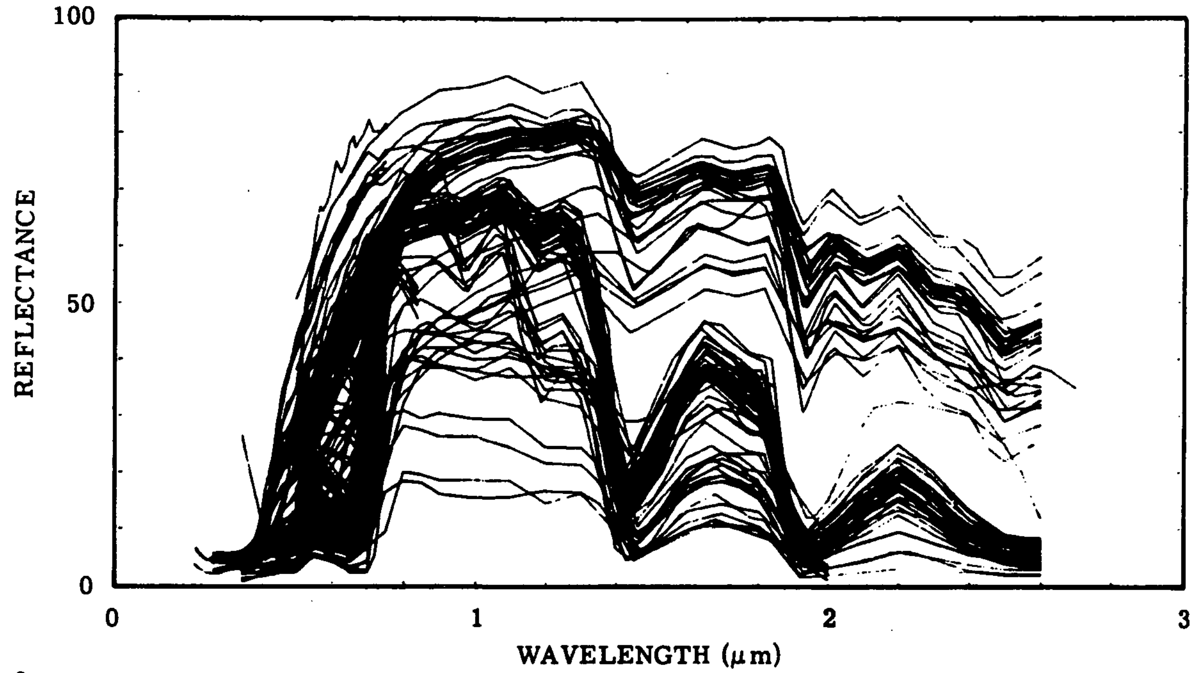
Third, different parts of the same plant may exhibit dissimilar reflectance spectra; this may introduce variations if a spectrum of some part of the plant (leaf) is compared with a spectrum of the whole plant (tree). Analytical models which account for these factors have yet to be developed. A fourth source of variability is found within broad categories of vegetation spectra; namely, the states of maturity and plant vigor vary from sample to sample. This is well illustrated in the composite plots by the "corn" category. This plot contains spectra for different parts of the plant at different stages of maturity and vigor. All of the spectra of young, vigorous corn, for instance, display distinct reflection minima near 0.63 μm (chlorophyll band), 1.4 μm (water band), and 1.9 μm (water band). The yellowing and brown mature corn, by contrast, exhibit a reflection minimum at 2.1 μm corresponding to the cellulose band, and diminished water and chlorophyll bands. One can gain an appreciation of these variations by first examining the composite plot entitled "All Corn" and then comparing this with the subcategories of corn in the following plots.

The remaining parts of this report contain the composite and single curve plots of all the ERSIS spectra; these plots are organized into subgroups of reasonable homogeneity. Whenever there are curves on the composites which have apparently been misclassified by the experimenter, the corresponding descriptors are noted. Below each composite plot is a list of all of the curves appearing in that plot.

4.1. COMPOSITE PLOTS

1

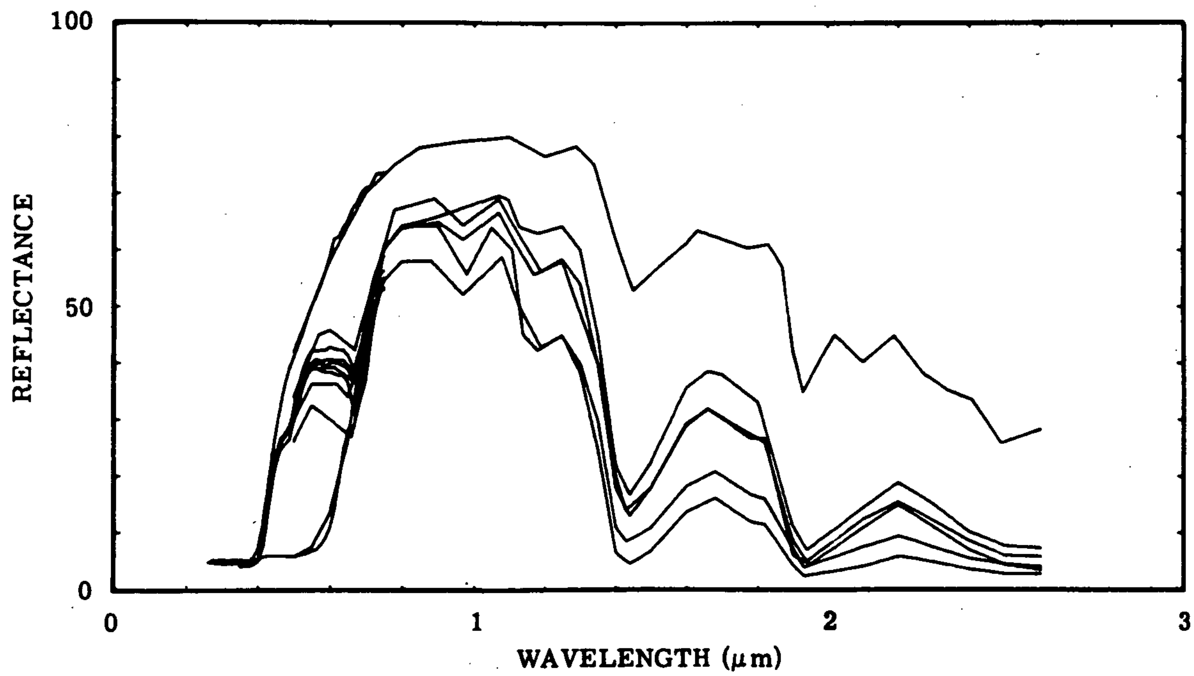
ALL CORN



2

CORN

Miscellaneous

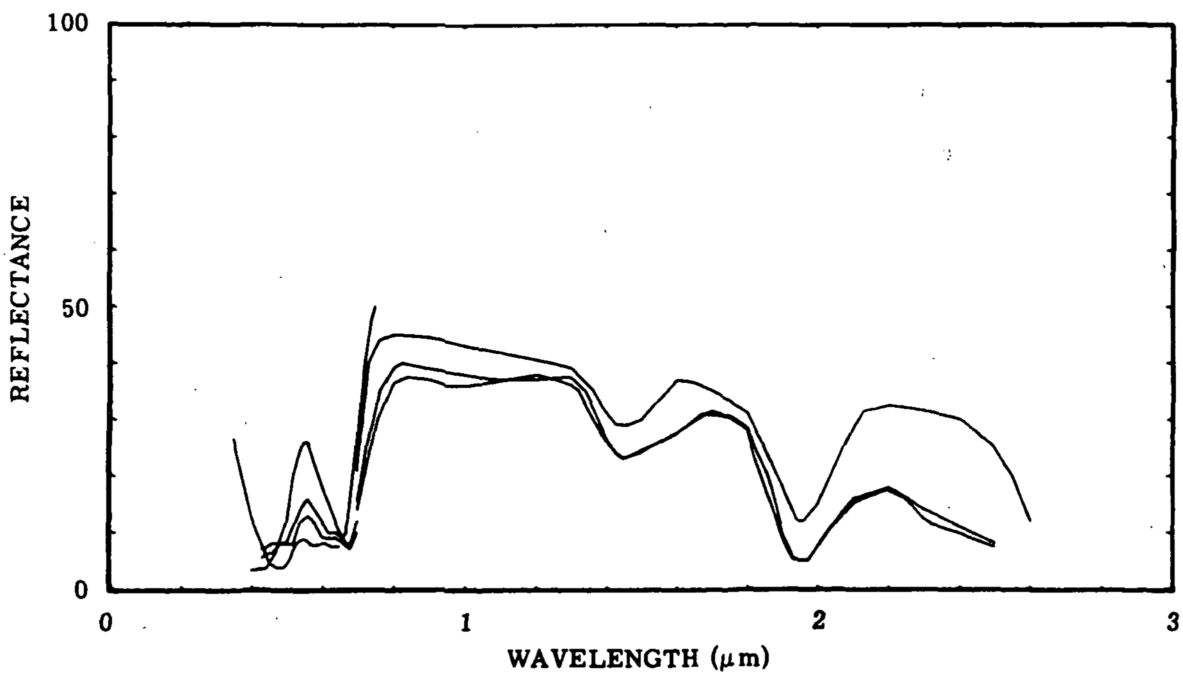


B02418-054	Corn leaf, dry, center vein near base, UV
B02418-055	Corn leaf, dry, center vein near base, visible
B02418-056	Corn leaf, dry, center vein near base, IR
B02418-115	Corn leaf, reddish color, UV
B02418-116	Corn leaf, reddish color, visible
B02418-117	Corn leaf, reddish color, IR
B02418-134	Corn leaf vein, wide vein near base of leaf, UV
B02418-135	Corn leaf vein, wide vein near base of leaf, visible
B02418-136	Corn leaf vein, wide vein near base of leaf, IR
B02418-137	Corn leaf vein, wide vein near base of leaf, UV
B02418-138	Corn leaf vein, wide vein near base of leaf, visible
N02418-139	Corn leaf vein, wide vein near base of leaf, IR
B02418-140	Corn leaf vein, wide vein near base of leaf, visible
B02418-141	Corn leaf vein, wide vein near base of leaf, IR
B02418-142	Corn leaf vein, wide vein near base of leaf, visible
B02418-143	Corn leaf vein, wide vein near base of leaf, IR

3

CORN

Miscellaneous Leaves



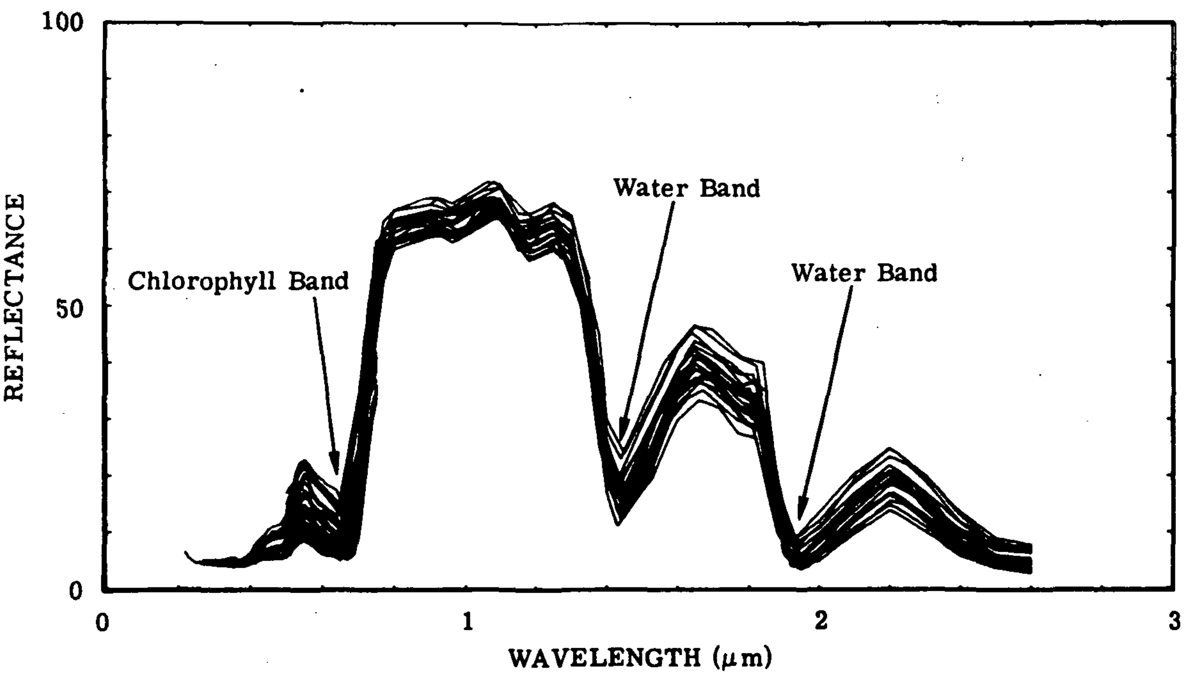
B01761-035	Corn (Zea maize), upper leaf surface
B01761-036	Corn (Zea maize), lower leaf surface

B01948-002	Corn, leaf
B01948-010	Maize, leaf
B01948-011	Maize, lower leaf surface
B01948-012	Maize, upper leaf surface
B20000-459	Corn leaf (Zea maize), killed by frost, upper leaf surface
B20000-460	Corn leaf (Zea maize), killed by frost, upper leaf surface
B20000-461	Corn leaf (Zea maize), killed by frost, upper leaf surface
B20000-462	Corn leaf (Zea maize), killed by frost, lower leaf surface
B20000-463	Corn leaf (Zea maize), killed by frost, lower leaf surface
B20000-464	Corn leaf (Zea maize), killed by frost, lower leaf surface

4

CORN

Live and Healthy



B02418-063	UV, corn leaf, green, tip of leaf, 2nd leaf from top of plant
B02418-064	Visible, corn leaf, green, tip of leaf, 2nd leaf from top of plant
B02418-065	IR, corn leaf, green, tip of leaf, 2nd leaf from top of plant
B02418-066	UV, corn leaf, green, center of leaf, 2nd leaf from top of plant
B02418-067	Visible, corn leaf, green, center of leaf, 2nd leaf from top of plant
B02418-068	IR, corn leaf, green, center of leaf, 2nd leaf from top of plant
B02418-069	UV, corn leaf, green, base of leaf, 2nd leaf from top of plant
B02418-070	Visible, corn leaf, green, base of leaf, 2nd leaf from top of plant

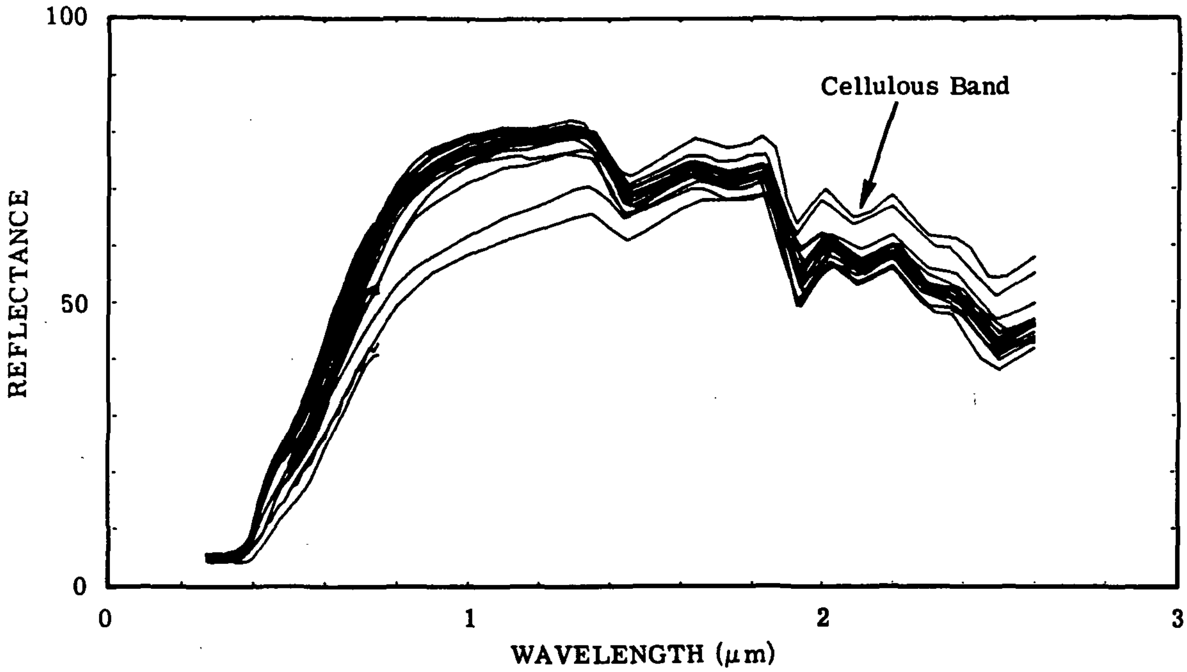
B02418-071	IR, corn leaf, green, base of leaf, 2nd leaf from top of plant
B02418-072	UV, corn leaf, green, tip of leaf, 2nd leaf from top of plant
B02418-073	Visible, corn leaf, green, tip of leaf, 2nd leaf from top of plant
B02418-074	IR, corn leaf, green, tip of leaf, 2nd leaf from top of plant
B02418-075	UV, corn leaf, green, center of leaf, 2nd leaf from top of plant
B02418-076	Visible, corn leaf, green, center of leaf, 2nd from top of plant
B02418-077	IR, corn leaf, green, center of leaf, 2nd leaf from top of plant
B02418-078	UV, corn leaf, green, base of leaf, 2nd leaf from top of plant
B02418-079	Visible, corn leaf, green, base of leaf, 2nd leaf from top of plant
B02418-080	IR, corn leaf, green, base of leaf, 2nd leaf from top of plant
B02418-081	Visible, corn leaf, green, tip of leaf, leaf from center of plant
B02418-082	IR, corn leaf, green, tip of leaf, leaf from center of plant
B02418-083	Visible, corn leaf, green, center of leaf, leaf from center of plant
B02418-084	IR, corn leaf, green, center of leaf, leaf from center of plant
B02418-085	Visible, corn leaf, green, base of leaf, leaf from center of plant
B02418-086	IR, corn leaf, green, base of leaf, leaf from center of plant
B02418-087	Visible, corn leaf, green, tip of leaf, leaf from base of plant
B02418-088	IR, corn leaf, green, tip of leaf, leaf from base of plant
B02418-089	Visible, corn leaf, green, center of leaf, leaf from base of plant
B02418-090	IR, corn leaf, green, center of leaf, leaf from base of plant
B02418-091	Visible, corn leaf, green, base of leaf, leaf from base of plant
B02418-092	IR, corn leaf, green, base of leaf, leaf from base of plant
B02418-093	UV, corn leaf, green
B02418-094	Visible, corn leaf, green
B02418-095	IR, corn leaf, green
B02418-096	Visible, corn leaf, green
B02418-097	IR, corn leaf, green
B02418-098	Visible, corn leaf, green
B02418-099	IR, corn leaf, green
B02418-100	Visible, corn leaf, green
B02418-101	IR, corn leaf, green
B02418-102	IR, corn leaf, green
B02418-103	IR, corn leaf, green
B02418-104	IR, corn leaf, green
B02418-105	Visible, corn leaf, medium green
B02418-106	IR, corn leaf, medium green
B02418-107	UV, corn leaf, green

B02418-108	Visible, corn leaf, green
B02418-109	IR, corn leaf, green

5

CORN

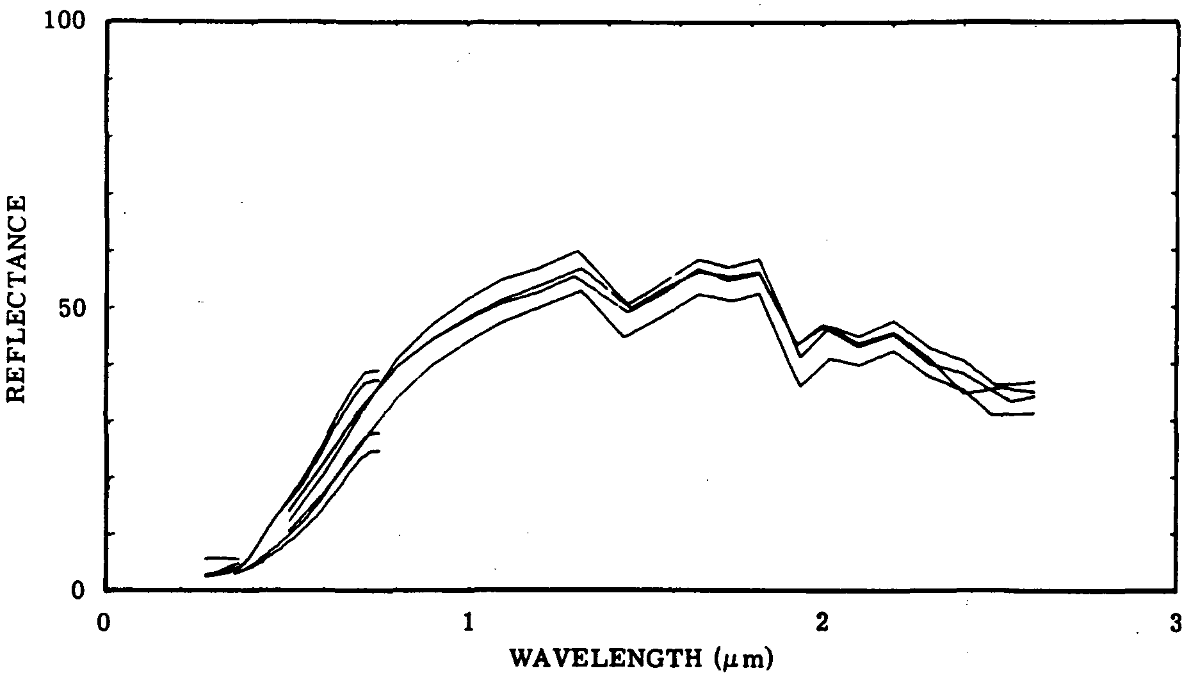
Mature (Brown)



B02418-001	UV, corn leaf, dry, brown, tip of leaf
B02418-002	Visible, corn leaf, dry, brown, tip of leaf
B02418-003	IR, corn leaf, dry, brown, tip of leaf
B02418-004	UV, corn leaf, dry, brown, center of leaf
B02418-005	Visible, corn leaf, dry, brown, center of leaf
B02418-006	IR, corn leaf, dry, brown, center of leaf
B02418-007	UV, corn leaf, dry, brown, center of leaf
B02418-008	Visible, corn leaf, dry, brown, center of leaf
B02418-009	IR, corn leaf, dry, brown, center of leaf
B02418-010	UV, corn leaf, dry, brown, base of leaf
B02418-011	Visible, corn leaf, dry, brown, base of leaf
B02418-012	IR, corn leaf, dry, brown, base of leaf
B02418-013	IR, corn leaf, dry, brown, base of leaf
B02418-014	UV, corn leaf, dry, brown, center of leaf
B02418-015	Visible, corn leaf, dry, brown, center of leaf
B02418-016	IR, corn leaf, dry, brown, center of leaf

B02418-017	UV, corn leaf, dry, brown, base of leaf, reddish brown
B02418-018	Visible, corn leaf, dry, brown, base of leaf, reddish brown
B02418-019	IR, corn leaf, dry, brown, base of leaf, reddish brown
B02418-020	UV, corn leaf, dry, brown, center of leaf
B02418-021	Visible corn leaf, dry, brown, center of leaf
B02418-022	IR, corn leaf, dry, brown, center of leaf
B02418-023	UV, corn leaf, dry, brown
B02418-024	Visible, corn leaf, dry, brown
B02418-025	IR, corn leaf, dry, brown
B02418-026	Visible, corn leaf, dry, brown
B02418-027	IR, corn leaf, dry, brown
B02418-028	IR, corn leaf, dry, brown
B02418-029	IR, corn leaf, dry, brown
B02418-030	IR, corn leaf, dry, brown
B02418-031	IR, corn leaf, dry, brown
B02418-032	Visible, corn leaf, dry, brown, lower surface
B02418-033	IR, corn leaf, dry, brown, lower surface
B02418-034	Visible, corn leaf, dry, brown, lower surface
B02418-035	IR, corn leaf, dry, brown, lower surface
B02418-036	UV, corn leaf, dry, brown, base of leaf, much black smut
B02418-037	Visible, corn leaf, dry, brown, base of leaf, much black smut
B02418-038	IR, corn leaf, dry, brown, base of leaf, much black smut
B02418-039	UV, corn leaf, dry, brown, tip of leaf, much black smut
B02418-040	Visible, corn leaf, dry, brown, tip of leaf, much black smut
B02418-041	IR, corn leaf, dry, brown, tip of leaf, much black smut
B02418-042	UV, corn leaf, dry, brown, tip of leaf, very smutty
B02418-043	Visible, corn leaf, dry, brown, tip of leaf, very smutty
B02418-044	IR, corn leaf, dry, brown, tip of leaf, very smutty

6
CORN
Tassels

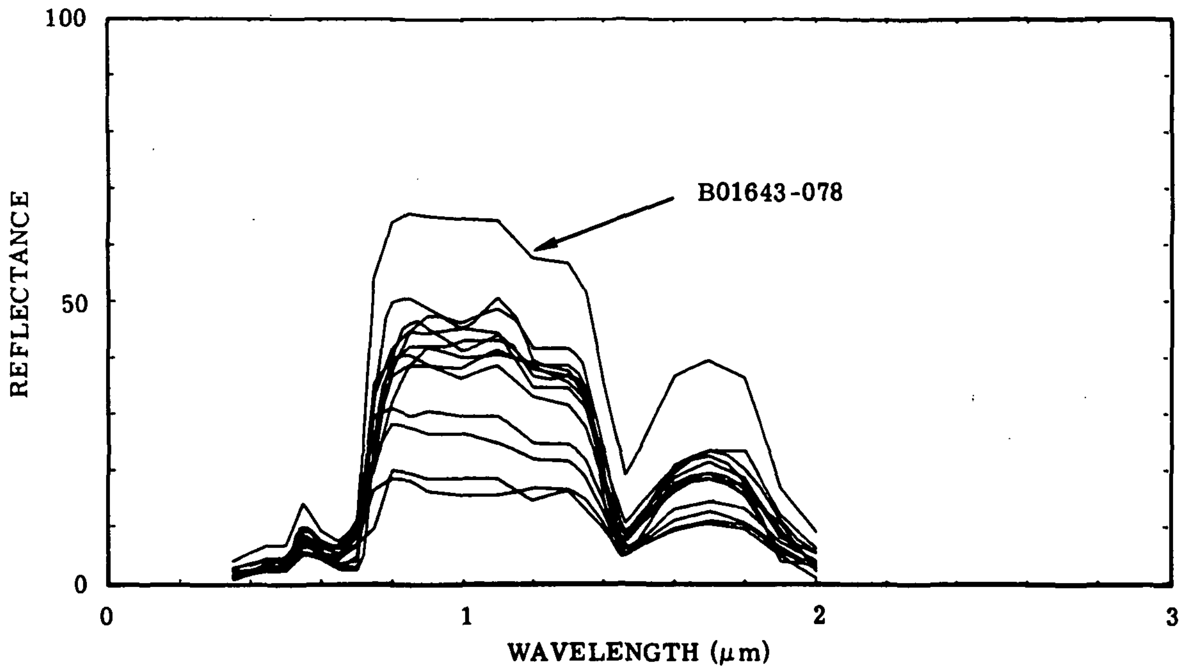


B02418-144	Corn tassel, dry, UV
B02418-145	Corn tassel, dry, visible
B02418-146	Corn tassel, dry, IR
B02418-147	Corn tassel, dry, UV
B02418-148	Corn tassel, dry, visible
B02418-149	Corn tassel, dry, IR
B02418-150	Corn tassel, dry, UV
B02418-151	Corn tassel, dry, visible
B02418-152	Corn tassel, dry, IR
B02418-153	Corn tassel, dry, UV
B02418-154	Corn tassel, dry, visible
B02418-155	Corn tassel, dry, IR

7

CORN

Normal Stand, USAERDL Field Data

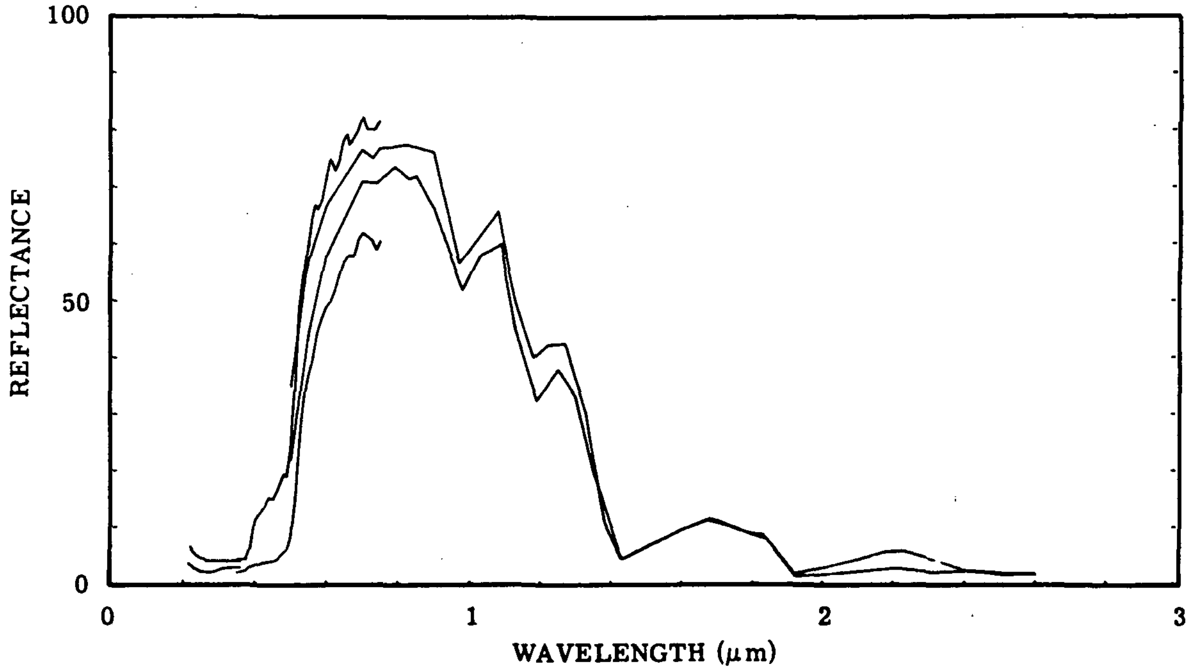


B01643-078	Corn, normal strand
B01643-079	Corn, normal strand
B01643-080	Corn, normal stand
B01643-081	Corn, thin stand
B01643-082	Corn, thin stand
B01643-083	Corn, thin stand
B01643-084	Corn, normal stand, weedy
B01643-085	Corn, normal stand, weedy
B01643-086	Corn, normal stand, susceptible
B01643-087	Corn, normal stand, susceptible
B01643-088	Corn, normal stand, disease resistant
B01643-089	Corn, normal stand, disease resistant
B01643-090	Corn, normal stand, disease resistant

8

CORN

Kernels

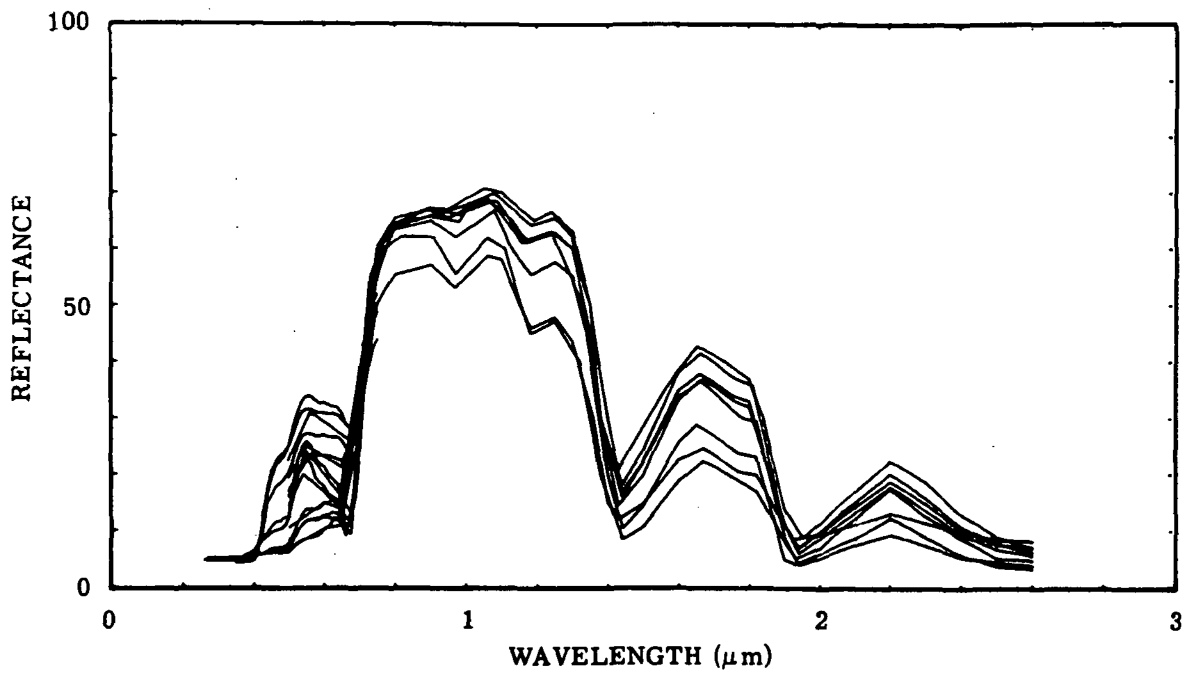


B02148-156	Corn kernel, dark yellow (dry corn), UV
B02418-157	Corn kernel, dark yellow, (dry corn), visible
B02418-158	Corn kernel, dark yellow, (dry corn), IR
B02418-159	Corn kernel, light yellow, (dry corn), UV
B02418-160	Corn kernel, light yellow, (dry corn), Visible
B02418-161	Corn kernel, light yellow (dry corn), IR

9

CORN

Multicolored (Reddish Colors)



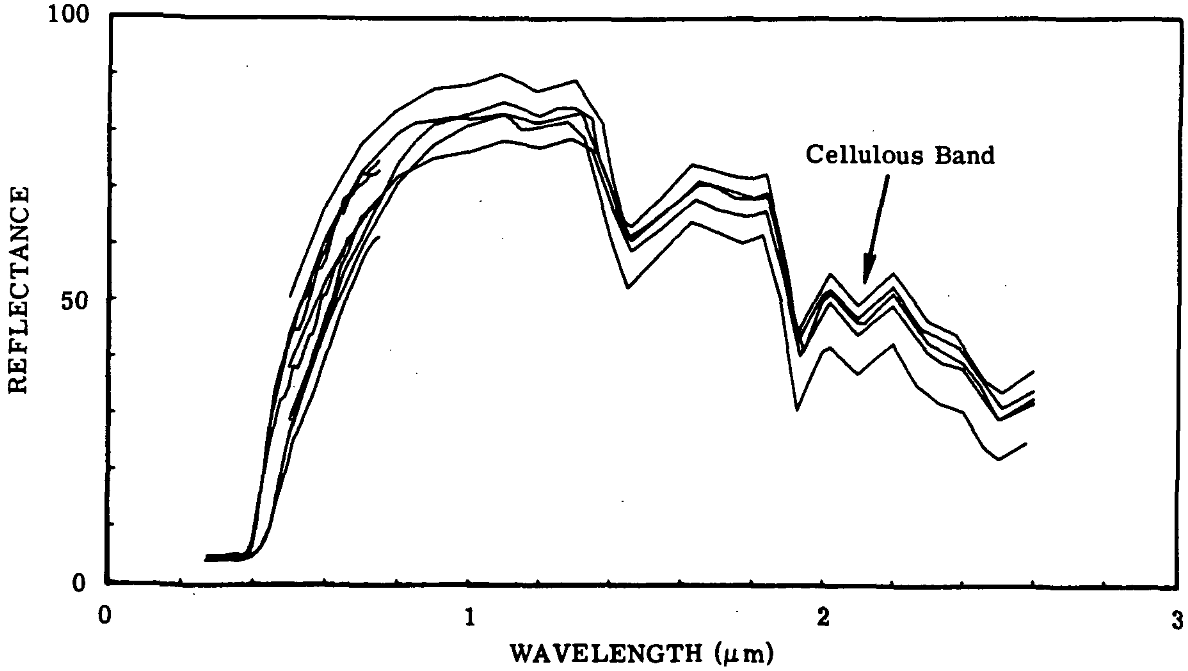
B02418-110	Corn leaf, light green, rather dry leaf, visible
B02418-111	Corn leaf, light green, rather dry leaf, IR
B02418-112	Corn leaf, dark reddish green, UV
B02418-113	Corn leaf, dark reddish green, visible
B02418-114	Corn leaf, dark reddish green, IR
B02418-118	Corn leaf, green-red color (half and half), UV
B02418-119	Corn leaf, green-red color (half and half), visible
B02418-120	Corn leaf, green-red color (half and half), IR
B02418-121	Corn leaf, dark greenish brown color, somewhat dry, UV
B02418-122	Corn leaf, dark greenish brown color, somewhat dry, visible
B02418-123	Corn leaf, dark greenish brown color, somewhat dry, IR
B02418-124	Corn leaf, green, thin vein near tip of leaf, light yellow, UV
B02418-125	Corn leaf, green, thin vein near tip of leaf, light yellow, visible
B02418-126	Corn leaf, green, thin vein near tip of leaf, light yellow, IR
B02418-127	Corn leaf vein, by green leaf tip, thin vein, light yellow, UV
B02418-128	Corn leaf vein, by green leaf tip, thin vein, light yellow, visible
B02418-129	Corn leaf vein, by green leaf tip, thin vein, light yellow, IR
B02418-130	Corn leaf vein

B02418-131	Corn, green leaf, thin pale light yellow vein by leaf tip, IR
B02418-132	Corn, green leaf, thin pale light yellow vein by leaf tip, visible
B02418-133	Corn, green leaf, thin pale light yellow vein by leaf tip, IR

10

CORN

Maturing (Yellow)

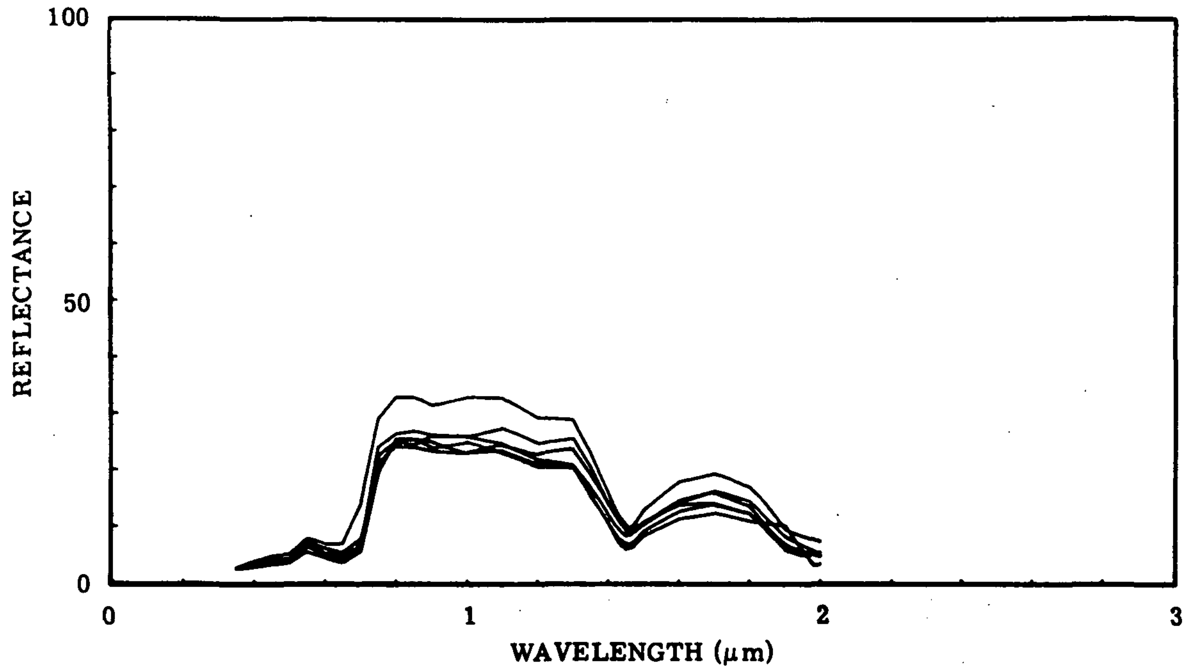


B02418-045	UV, corn leaf, dry vein, light yellow, thin
B02418-046	Visible, corn leaf, dry vein, light yellow, thin
B02418-047	IR, corn leaf, dry vein, light yellow, thin
B02418-048	UV, corn leaf, dry, center vein near tip, light yellow, thin
B02418-049	Visible, corn leaf, dry, center vein near tip, light yellow, thin
B02418-050	IR, corn leaf, dry, center vein near tip, light yellow, thin
B02418-051	UV, corn leaf, dry, center vein near tip, bright yellow, thin
B02418-052	Visible, corn leaf, dry, center vein near tip, bright yellow, thin
B02418-053	IR, corn leaf, dry, center vein near tip, bright yellow, thin
B02418-057	UV, corn leaf, dry, center vein near base, light yellow
B02418-058	Visible, corn leaf, dry, center vein near base, light yellow
B02418-059	IR, corn leaf, dry, center vein near base, light yellow
B02418-060	UV, corn leaf, dry, center vein near base, bright yellow
B02418-061	Visible, corn leaf, dry, center vein near base, bright yellow
B02418-062	IR, corn leaf, dry, center vein near base, bright yellow

11

OATS

USAERDL Field Data

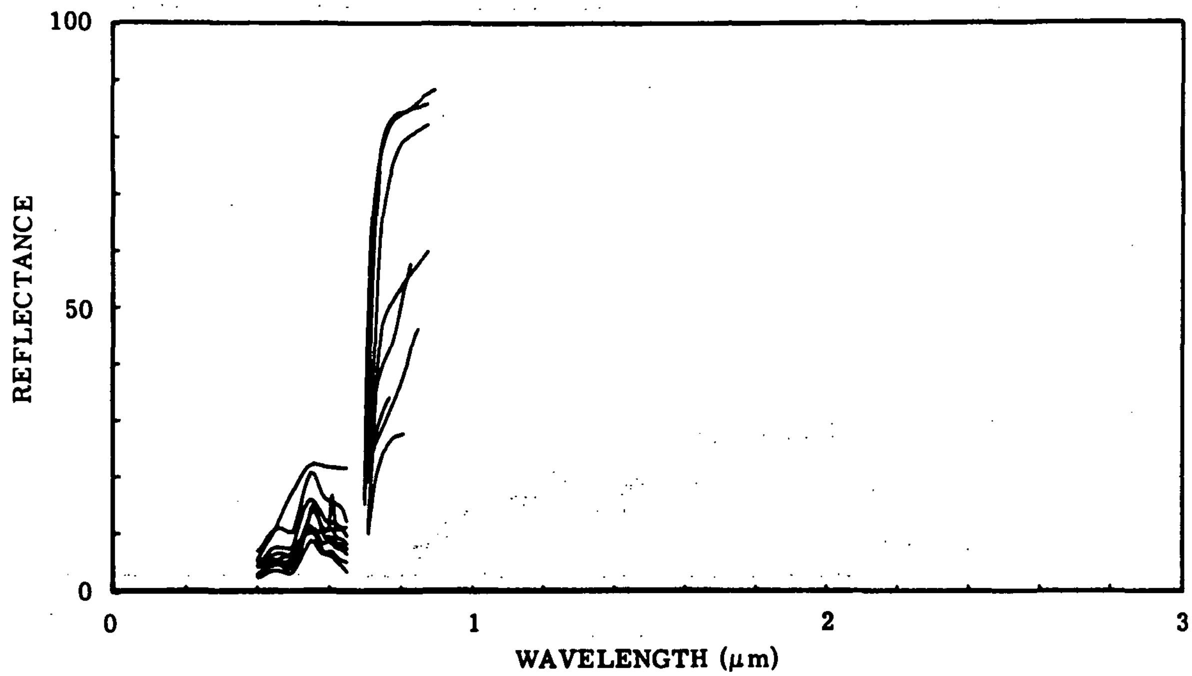


B01643-001	Oats, normal stand
B01643-002	Oats, normal stand
B01643-003	Oats, normal stand
B01643-004	Oats, normal stand, weedy
B01643-005	Oats, normal stand, weedy
B01643-006	Oats, normal stand, weedy

12

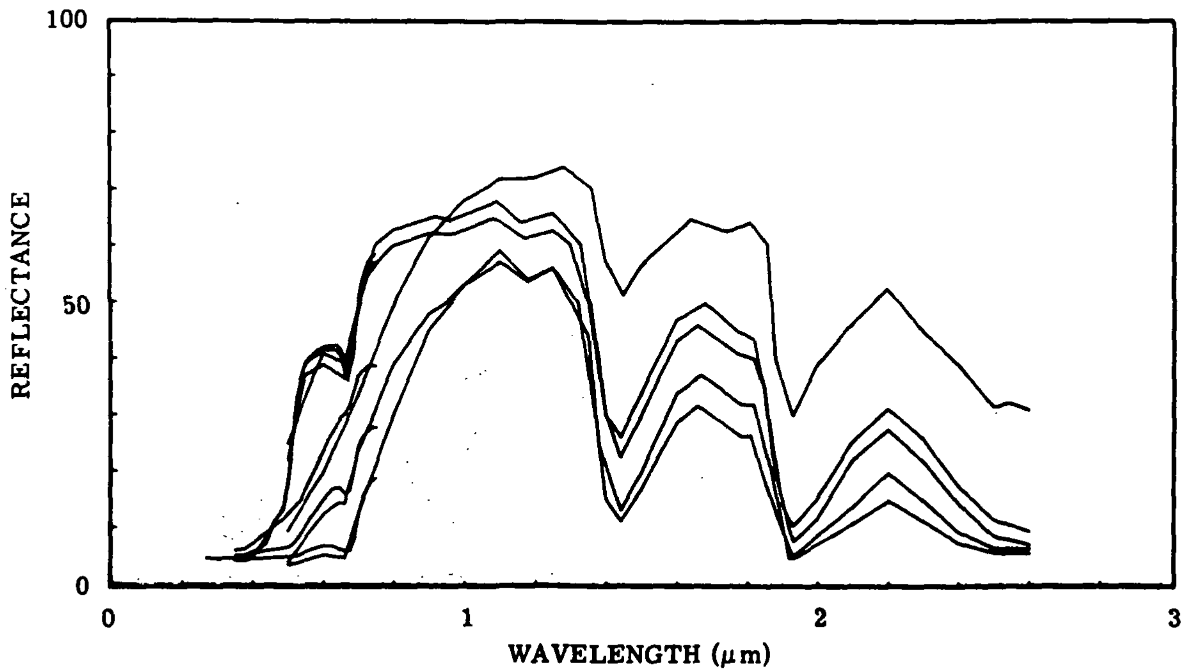
OATS

Spiked Field, Krinov Field Data



B03995-185	Oats, spike-forming period, normal
B03995-186	Oats, with spikes, on tundra
B03995-187	Oats, with spikes, on tundra
B03995-188	Oats, with spikes, on tundra
B03995-189	Oats, with spikes, lighter in color, cloudy
B03995-190	Oats, with spikes, lighter in color, cloudy
B03995-191	Oats, with spikes, lighter in color, cloudy
B03995-193	Oat field, stubble, normal
B03995-217	Oat straw, in sheaves, normal, black earth

13
SOYBEANS
Miscellaneous

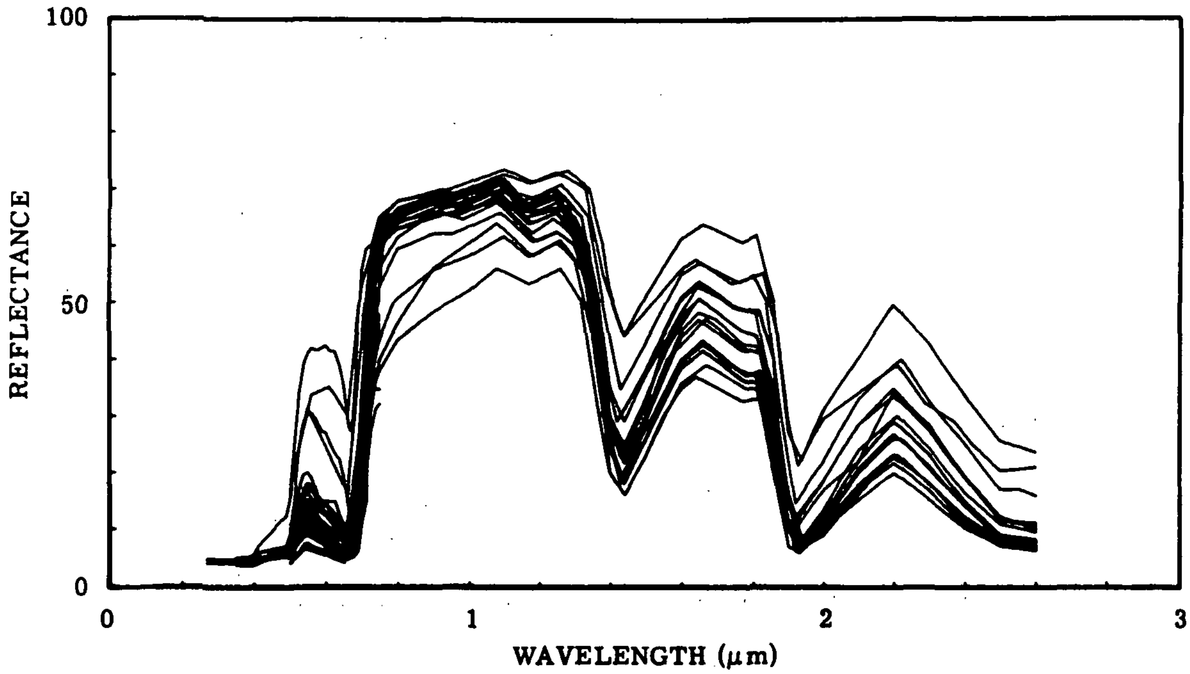


B02418-214	UV, soybean leaf, yellow
B02418-215	Visible, soybean leaf, yellow
B02418-216	IR, soybean leaf, yellow
B02418-238	Visible, soybean leaf, dry-brown, dry leaf
B02418-239	IR, soybean leaf, dry-brown, dry leaf
B02418-248	Visible, soybean leaf, yellow, moist
B02418-249	IR, Soybean leaf, yellow, moist
B02418-254	Visible, soybean leaf, deep reddish purple
B02418-255	IR, soybean leaf, deep reddish purple
B02418-256	Visible, soybean leaf, yellow-brown leaf
B02418-257	IR, soybean leaf, yellow-brown leaf

14

SOYBEANS

Live and Healthy



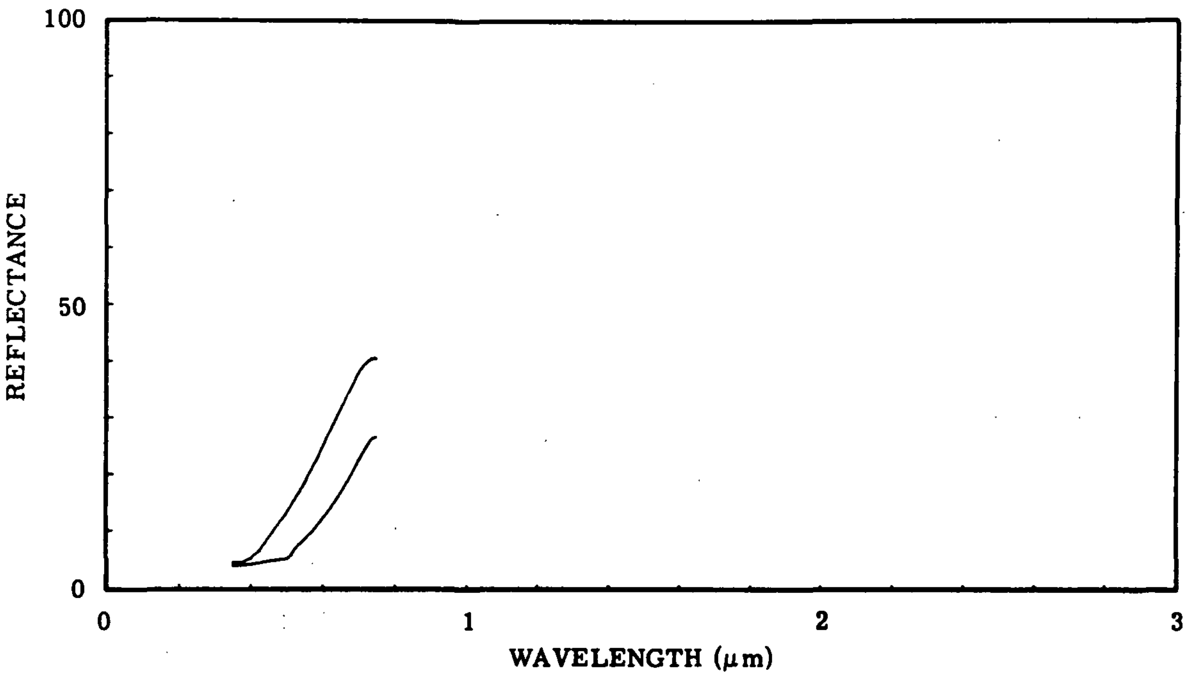
B02418-199	UV, soybean leaf, medium light green
B02418-200	Visible leaf, medium light green
B02418-201	IR, soybean leaf, medium light green
B02418-202	UV, soybean leaf, light green
B02418-203	Visible, soybean leaf, light green
B02418-204	IR, soybean leaf, light green
B02418-205	UV, soybean leaf, light green
B02418-206	Visible, soybean leaf, light green
B02418-207	IR, soybean leaf, light green
B02418-208	UV, soybean leaf, medium dark green
B02418-210	IR, soybean leaf, medium dark green
B02418-211	UV, soybean leaf, light greenish yellow
B02418-212	Visible, soybean leaf, light greenish yellow
B02418-213	IR, soybean leaf, light greenish yellow
B02418-217	UV, soybean leaf, dark green
B02417-218	Visible, soybean leaf, dark green
B02418-219	IR, soybean leaf, dark green
B02418-220	Visible, soybean leaf, dark green

B02418-221	IR, soybean leaf, dark green
B02418-222	Visible, soybean leaf, dark green
B02418-223	IR, soybean leaf, dark green
B02418-224	Visible, soybean leaf, dark green
B02418-225	IR, soybean leaf, dark green
B02418-226	Visible, soybean leaf, dark green
B02418-227	IR, soybean leaf, dark green
B02418-228	Visible, soybean leaf, dark green
B02418-229	IR, soybean leaf, dark green
B02418-230	Visible, soybean leaf, dark green
B02418-231	IR, soybean leaf, dark green
B02418-232	Visible, soybean leaf, medium green
B02418-233	IR, soybean leaf, medium green
B02418-234	Visible, soybean leaf, medium green
B02418-235	IR, soybean leaf, medium green
B02418-236	Visible, soybean leaf, yellow greenish brown leaf, frost damaged
B02418-237	IR, soybean leaf, yellow greenish brown leaf, frost damaged
B02418-240	Visible, soybean leaf, dark green, with red pustules appearing as rust
B02418-241	IR, soybean leaf, dark green, with red pustules appearing as rust
B02418-242	Visible, soybean leaf, dark green, blackish green, frost damage
B02418-243	IR, soybean leaf, dark green, blackish green, frost damage
B02418-244	Visible, soybean leaf, yellow-green leaf with veins almost brown
B02418-245	IR, soybean leaf, yellow-green leaf with veins almost brown
B02418-246	Visible, soybean leaf, dark green, healthy, moist
B02418-247	IR, soybean leaf, dark green, healthy, moist
B02418-250	Visible, soybean leaf, light greenish brown, wilted, frost damaged
B02418-251	IR, soybean leaf, light greenish brown, wilted, frost damaged
B02418-252	Visible, soybean leaf, dark green, healthy, little frost damage
B02418-253	IR, soybean leaf, dark green, healthy, little frost damage

15

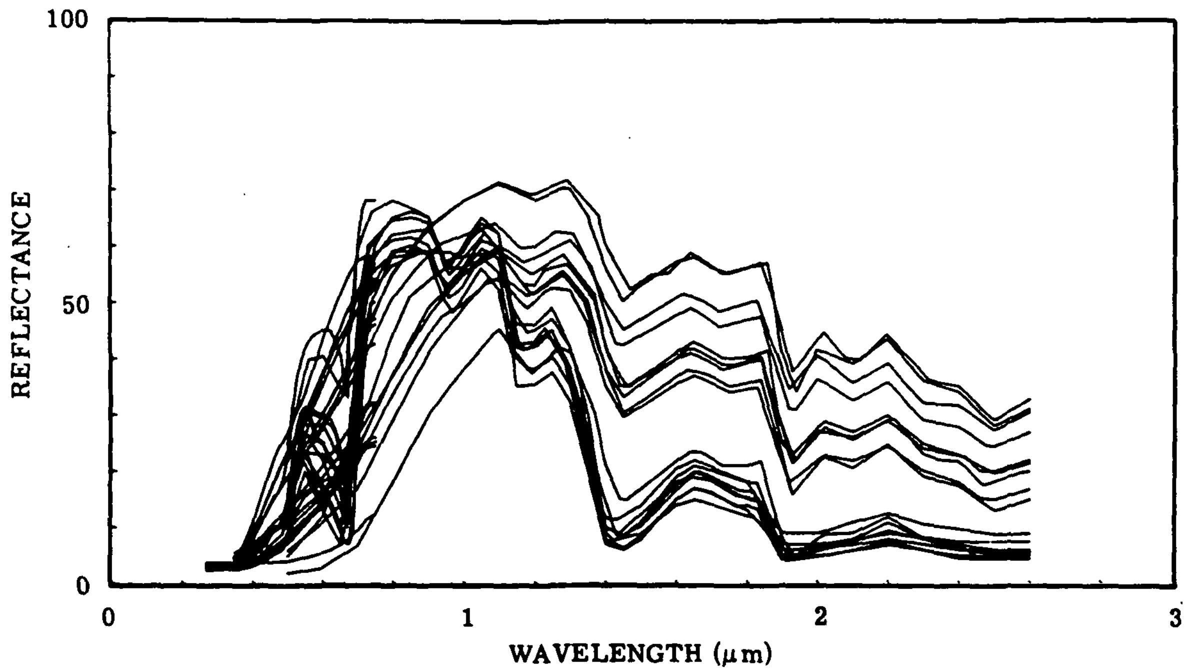
SOYBEANS

Stems



B02418-258	Visible, soybean stem, brown, (Shelby)
B02418-260	Visible, soybean stem, light brown (Hawkeye 63)

16
SOYBEAN
Pods



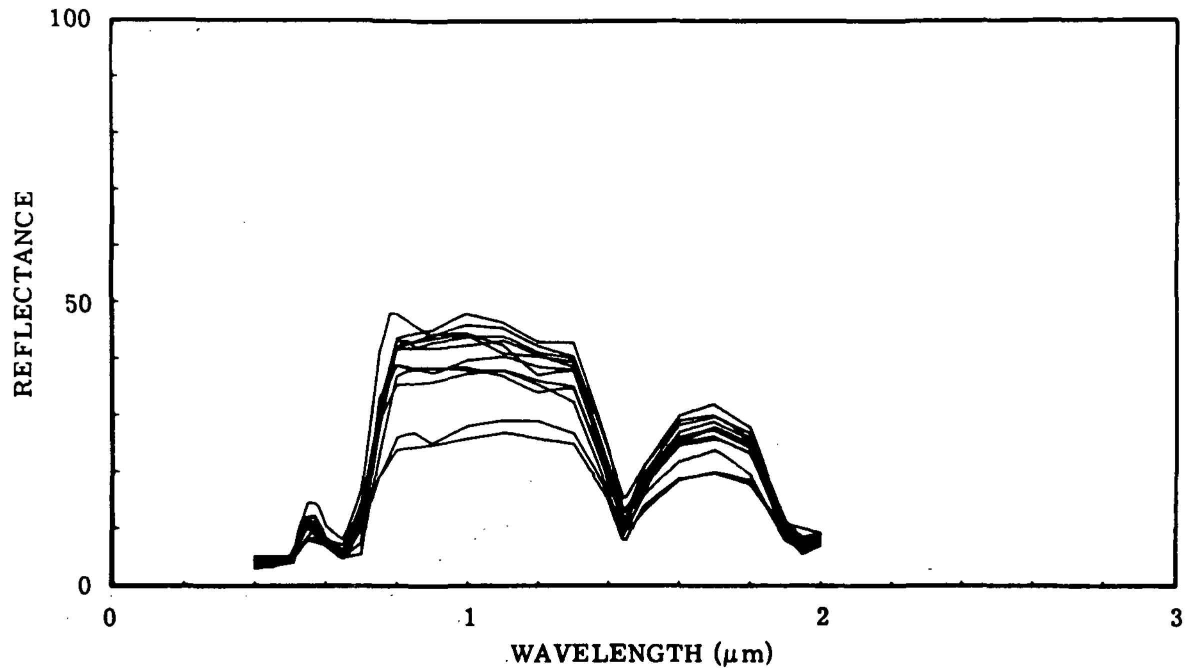
B02418-262	Visible, soybean pod, green, immature
B02418-263	IR, soybean pod, green, immature
B02418-264	Visible, soybean pod, brown, dry, (Shelby, hairy)
B02418-265	IR, soybean pod, brown, dry, (Shelby, hairy)
B02418-266	Visible, soybean pod, light brown, dry, (Hawkeye 63)
B02418-267	IR, soybean pod, light brown, dry, (Hawkeye 63)
B02418-268	Visible, soybean pod, immature, green
B02418-269	IR, soybean pod, immature, green
B02418-270	Visible, soybean pod, immature, green, frost damaged
B02418-271	IR, soybean pod, immature, green, frost damaged
B02418-272	Visible, soybean pod, immature, yellow, beginning to mature
B02418-273	IR, soybean pod, immature, yellow, beginning to mature
B02418-274	UV, soybean pod, immature, green, a few brown hairs
B02418-275	Visible, soybean pod, immature, green, a few brown hairs
B02418-276	IR, soybean pod, immature, green, a few brown hairs
B02418-277	UV, soybean pod, immature, yellow, a few brown hairs
B02418-278	Visible, soybean pod, immature, yellow, a few brown hairs
B02418-279	IR, soybean pod, immature, yellow, a few brown hairs

B02418-280	UV, soybean pod, immature, green, white hairs
B02318-281	Visible, soybean pod, immature, green, white hairs
B02418-282	IR, soybean pod, immature, green, white hairs
B02418-283	UV, soybean pod, immature, yellow, white hairs
B02418-284	Visible, soybean pod, immature, yellow, white hairs
B02418-285	IR, soybean pod, immature, yellow, white hairs
B02418-286	UV, soybean pod, mature, purplish black, hairless
B02418-287	Visible, soybean pod, mature, purplish black, hairless
B02418-288	IR, soybean pod, mature, purplish black, hairless
B02418-289	UV, soybean pod, mature, whitish brown, white hairs
B02418-290	Visible, soybean pod, mature, whitish brown, white hairs
B02418-291	IR, soybean pod, mature, whitish brown, white hairs
B02418-292	UV, soybean pod, mature, orange-brown, brown hairs
B02418-293	Visible, soybean pod, mature, orange-brown, brown hairs
B02418-294	IR, soybean pod, mature, orange-brown, brown hairs
B02418-295	UV, soybean pod, mature, dark grayish brown pod
B02418-296	Visible, soybean pod, mature, dark grayish brown pod
B02418-297	IR, soybean pod, mature, dark grayish brown pod
B02418-298	Visible, soybean pod, mature, light brown (Hawkeye 63)
B02418-299	IR, soybean pod, mature, light brown (Hawkeye 63)
B02418-300	Visible, soybean pod, mature, dark brown (Shelby)
B02418-301	IR, soybean pod, mature, dark brown (Shelby)
B02418-302	Visible, soybean pod, mature, (Harosody 63)
B02418-303	IR, soybean pod, mature, (Harosody 63)
B02418-304	Visible, soybean pod, mature, (Harosody 63)
B02418-305	IR, soybean pod, mature, (Harosody 63)

17

SOYBEANS

Normal Stand, USAERDL Field Data

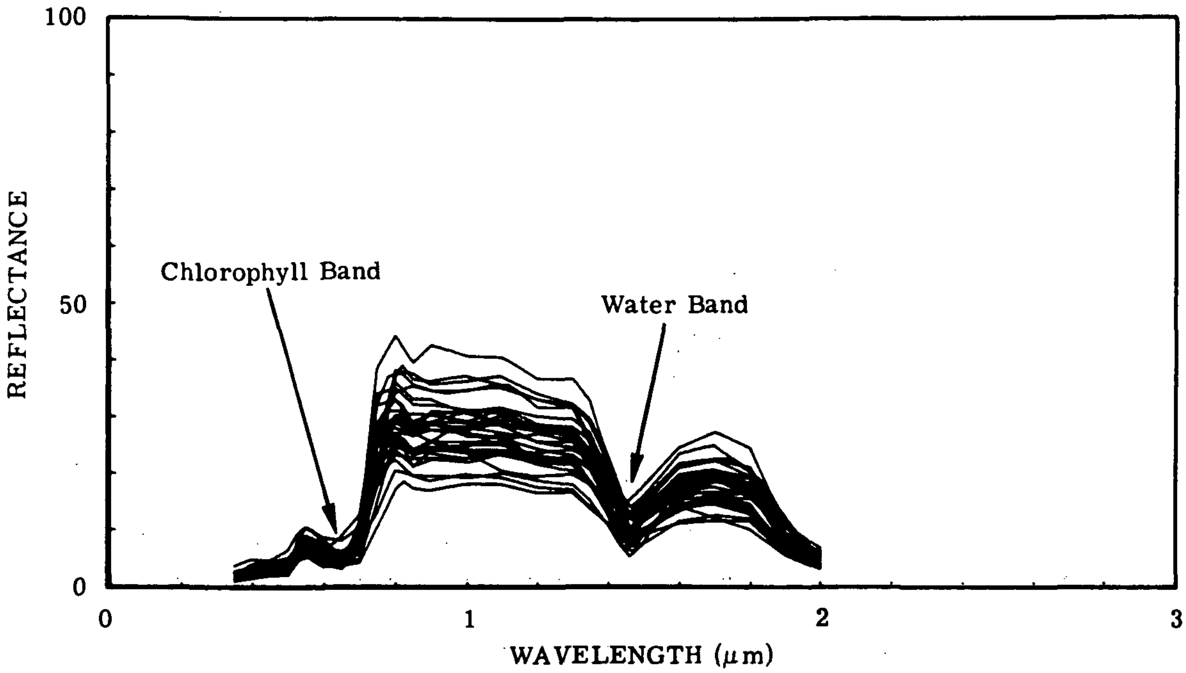


B01643-013	Soybeans, normal stand
B01643-014	Soybeans, normal stand
B01643-015	Soybeans, normal stand
B01643-016	Soybeans, thin stand
B01643-017	Soybeans, thin stand
B01643-018	Soybeans, normal stand, weedy
B01643-019	Soybeans, normal stand, weedy
B01643-020	Soybeans, normal stand, weedy
B01643-021	Soybeans, normal stand
B01643-022	Soybeans, normal stand
B01643-023	Soybeans, normal stand

18

SOYBEANS

Flowering Stage, USAERDL Field Data



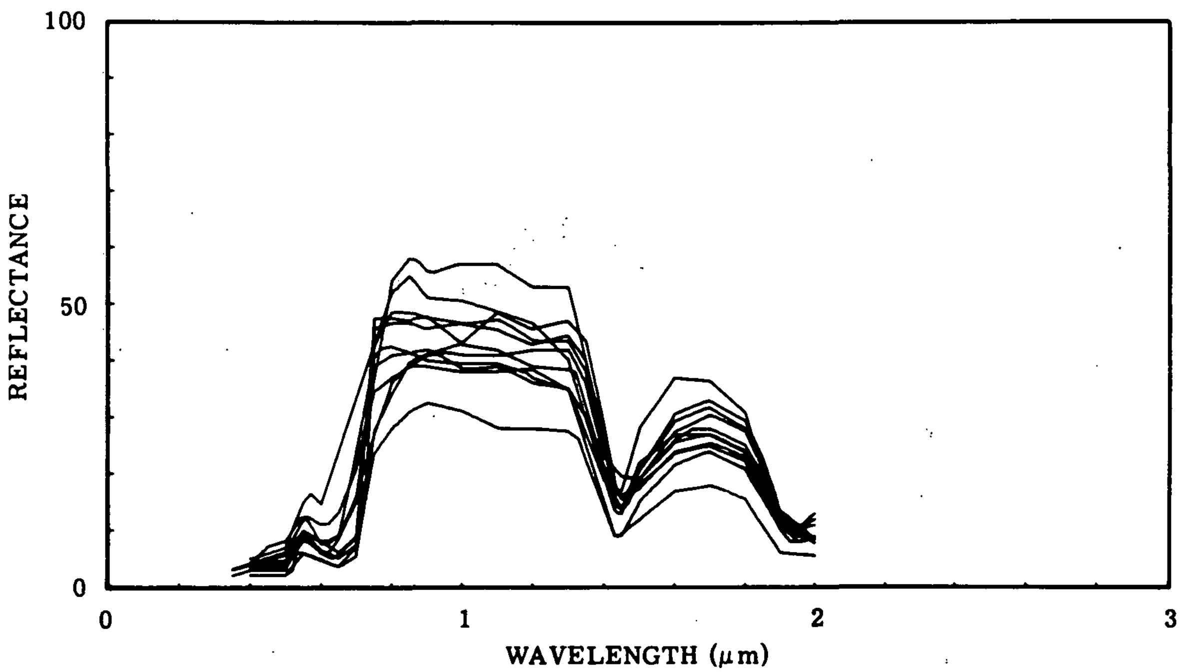
B01643-048	Soybeans, flowering stage, low moisture
B01643-049	Soybeans, flowering stage, low moisture
B01643-050	Soybeans, flowering stage, low moisture
B01643-051	Soybeans, flowering stage, low moisture
B01643-052	Soybeans, flowering stage, low moisture
B01643-053	Soybeans, flowering stage, high moisture
B01643-054	Soybeans, flowering stage, high moisture
B01643-055	Soybeans, flowering stage, high moisture
B01643-056	Soybeans, flowering stage, high moisture
B01643-057	Soybeans, flowering stage, high moisture
B01643-058	Soybeans, flowering stage, low fertilizer
B01643-059	Soybeans, flowering stage, low nitrogen
B01643-060	Soybeans, flowering stage, low nitrogen
B01643-061	Soybeans, flowering stage, low nitrogen
B01643-062	Soybeans, flowering stage, low nitrogen
B01643-063	Soybeans, flowering stage, high fertilizer
B01643-064	Soybeans, flowering stage, high nitrogen
B01643-065	Soybeans, flowering stage, high nitrogen

B01643-066	Soybeans, flowering stage, high nitrogen
B01643-067	Soybeans, flowering stage, high nitrogen
B01643-068	Soybeans, flowering stage, light background
B01643-069	Soybeans, flowering stage, light background
B01643-070	Soybeans, flowering stage, light background
B01643-071	Soybeans, flowering stage, light background
B01643-072	Soybeans, flowering stage, light background
B01643-073	Soybeans, flowering stage, normal background
B01643-074	Soybeans, flowering stage, normal background
B01643-075	Soybeans, flowering stage, normal background
B01643-076	Soybeans, flowering stage, normal background
B01643-077	Soybeans, flowering stage, normal background

19

SOYBEANS

Seedling Stage, USAERDL Field Data



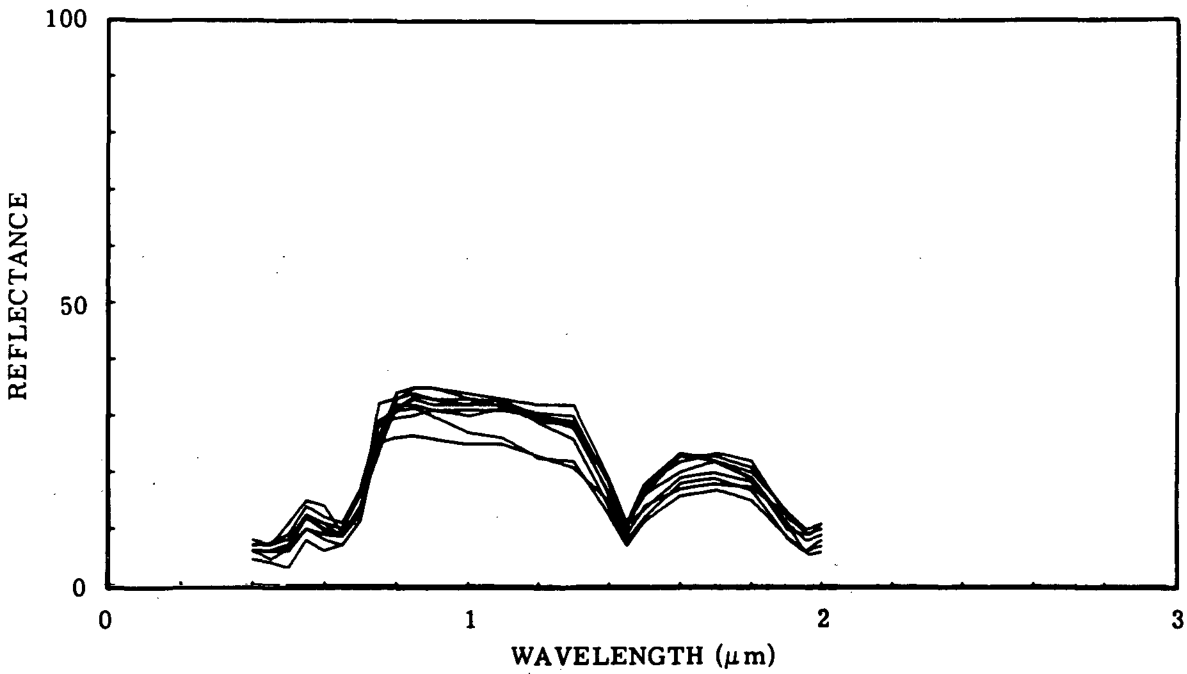
B01643-097	Soybeans, seedling stage, low moisture
B01643-098	Soybeans, seedling stage, low moisture
B01643-099	Soybeans, seedling stage, high moisture
B01643-100	Soybeans, seedling stage, high moisture
B01643-101	Soybeans, seedling stage, low fertilizer
B01643-102	Soybeans, seedling stage, low fertilizer

B01643-103	Soybeans, seedling stage, high fertilizer
B01643-104	Soybeans, seedling stage, high fertilizer
B01643-105	Soybeans, seedling stage, light background
B01643-106	Soybeans, seedling stage, light background
B01643-107	Soybeans, seedling stage, normal background
B01643-108	Soybeans, seedling stage, normal background

20

BARLEY

USAERDL Field Data

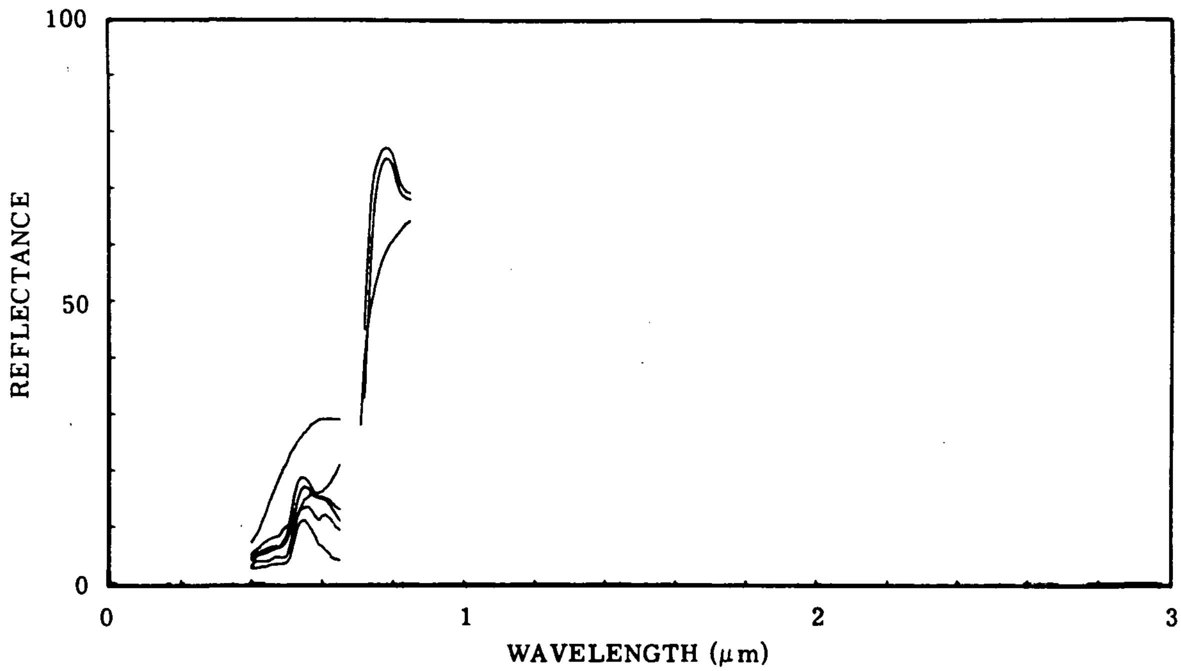


B01643-182	Barley, noninoculated
B01643-183	Barley, noninoculated
B01643-184	Barley, noninoculated
B01643-185	Barley, inoculated resistant
B01643-186	Barley, inoculated resistant
B01643-187	Barley, inoculated resistant
B01643-188	Barley, mildewed
B01643-189	Barley, mildewed
B01643-190	Barley, mildewed

21

BARLEY

Spiked Field, Krinov Field Data

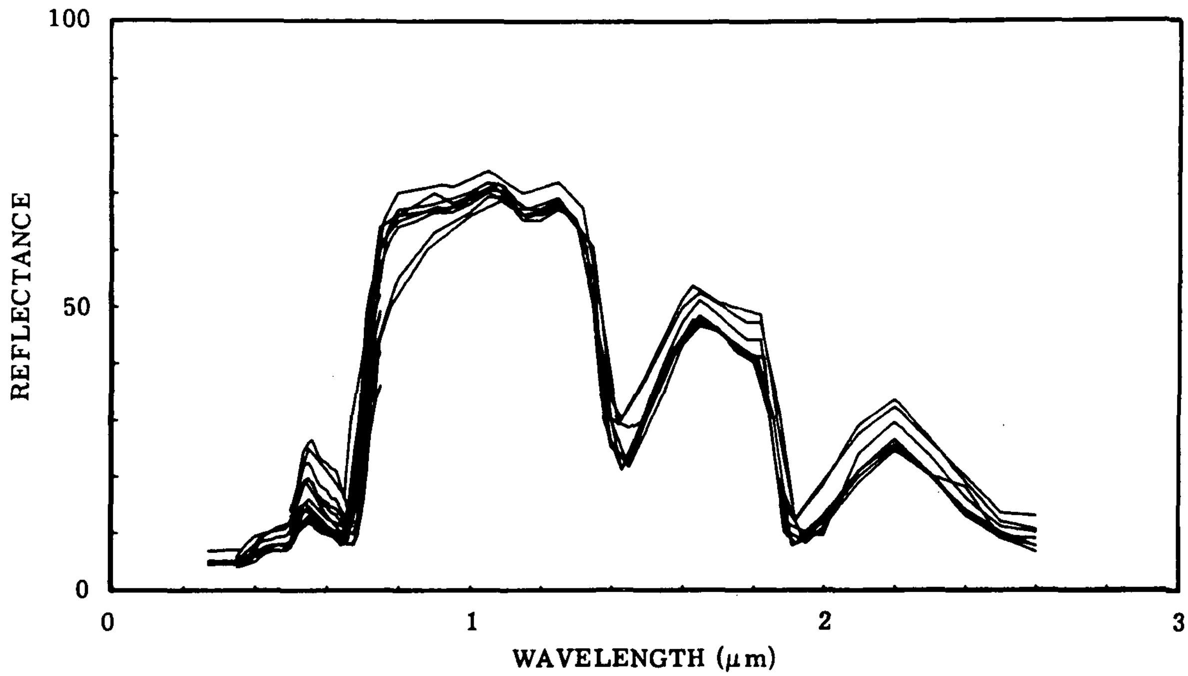


B03995-195	Barley field, stubble, normal
B03995-223	Barley, before spikes
B03995-224	Barley, spiked
B03995-225	Barley, spiked
B03995-226	Barley, spiked
B03995-227	Barley, golden yellow-ripe

22

SORGHUM

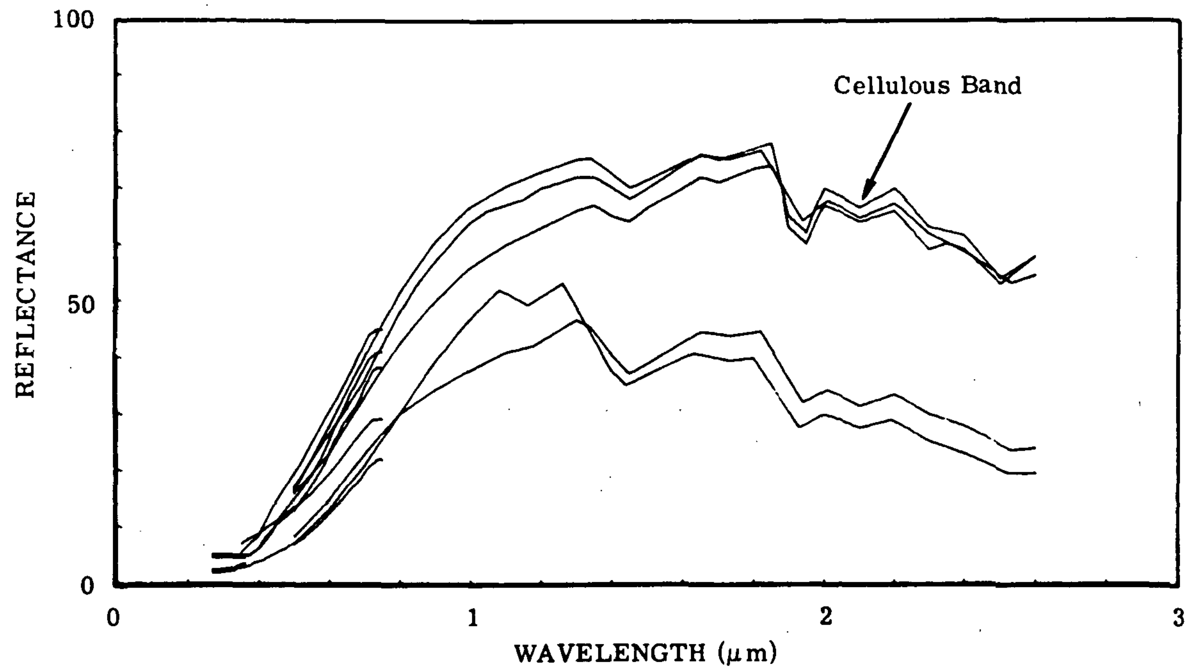
Live and Healthy



B02418-162	UV, sorghum leaf, dark green, moist, Pioneer 940
B02418-163	Visible, sorghum leaf, dark green, moist, Pioneer 940
B02418-164	IR, sorghum leaf, dark green, moist, Pioneer 940
B02418-165	UV, sorghum leaf, light green, moist, Atlas
B02418-166	Visible, sorghum leaf, light green, moist, Atlas
B02418-167	IR, sorghum leaf, light green, moist, Atlas
B02418-168	Visible, sorghum leaf, dark green, moist, tall variety by Recorder
B02418-169	IR, sorghum leaf, dark green, moist, tall variety by Recorder
B02418-170	Visible, sorghum leaf, light green, moist, tall variety by Recorder
B02418-171	IR, sorghum leaf, light green, moist, tall variety by Recorder
B02418-172	UV, sorghum leaf, green, (seed head green) (grain sorghum)
B02418-173	Visible, sorghum leaf, green, (seed head green) (grain sorghum)
B02418-174	IR, sorghum leaf, green, (seed head green) (grain sorghum)
B02418-175	UV, sorghum leaf, yellowish green, (seed head green)
B02418-176	Visible, sorghum leaf, yellowish green, (seed head green)
B02418-177	IR, sorghum leaf, yellowish green, (seed head green)
B02418-178	UV, sorghum leaf, (grain sorghum), green, (seed head red)
B02418-179	Visible, sorghum leaf, (grain sorghum), green, (seed head red)

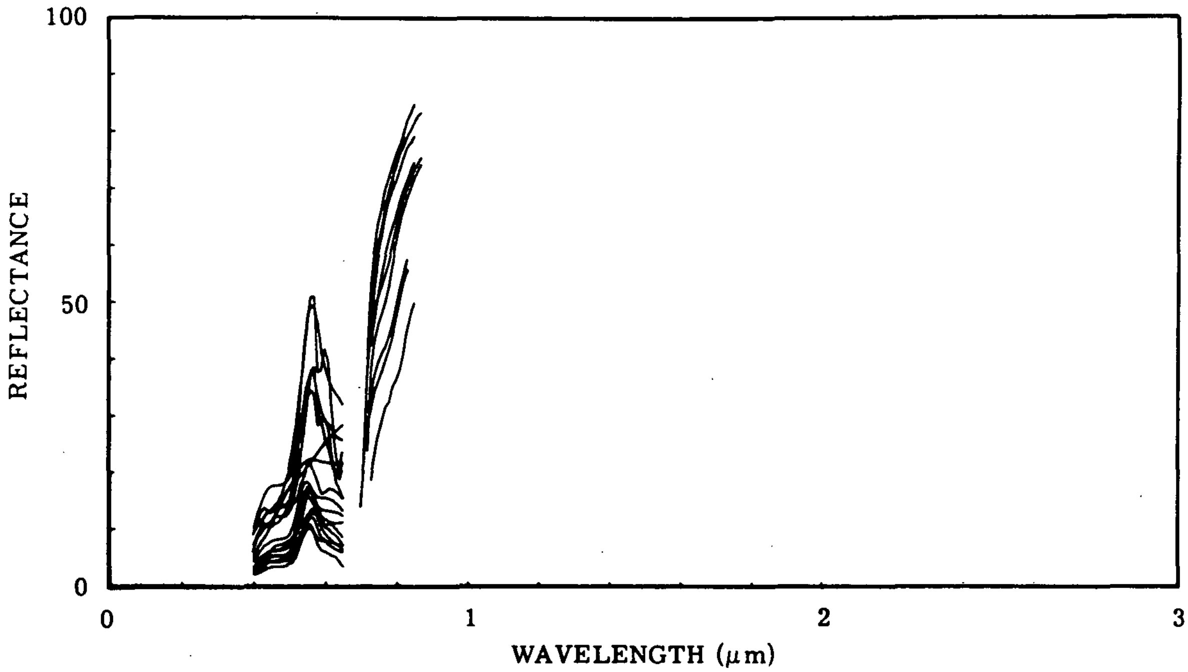
B02418-180 IR, sorghum leaf, (grain sorghum), green, (seed head red)
B02418-181 UV, sorghum leaf, grain sorghum, yellowish green, (seed head red)
B02418-182 Visible, sorghum leaf, grain sorghum, yellowish green, (seed head red)
B02418-183 IR, sorghum leaf, grain sorghum, yellowish green, (seed head red)

23
SORGHUM
Almost Dead



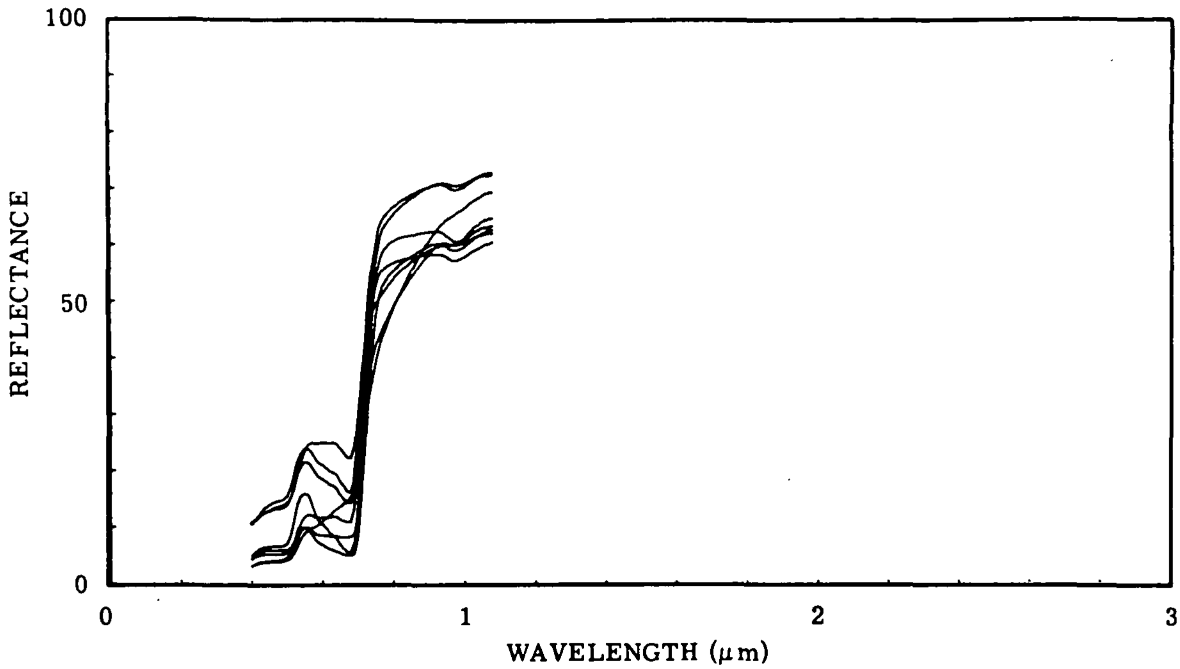
B02418-184 UV, sorghum leaf, grain sorghum, dry, brown leaf, (seed head red)
B02418-185 Visible, sorghum leaf, grain sorghum, dry, brown leaf, (seed head red)
B02418-186 IR, sorghum leaf, grain sorghum, dry, brown leaf, (seed head red)
B02418-187 UV, sorghum leaf, very dry, dark brown leaf (seed head green)
B02418-188 Visible, sorghum leaf, very dry, dark brown leaf (seed head green)
B02418-189 IR, sorghum leaf, very dry, dark brown leaf (seed head green)
B02418-190 UV, sorghum leaf, dry, (milkmaker variety)
B02418-191 Visible, sorghum leaf, dry, (milkmaker variety)
B02418-192 IR, sorghum leaf, dry, (milkmaker variety)
B02418-193 UV, sorghum head, dry, reddish brown, Pioneer 940
B02418-194 Visible, sorghum head, dry, reddish brown, Pioneer
B02418-195 IR, sorghum head, dry, reddish brown, Pioneer 940
B02418-196 UV, sorghum head, dry, brownish black, NK 300
B02418-197 Visible, sorghum head, dry, brownish black, NK 300
B02418-198 IR, sorghum head, dry, brownish black, NK 300

24
WHEAT
Krinov Field Data



B03995-201	Wheat, before harvesting
B03995-202	Wheat, before harvesting
B03995-203	Wheat, before harvesting
B03995-204	Wheat, before harvesting
B03995-205	Wheat, before harvesting
B03995-206	Wheat, before harvesting
B03995-207	Wheat, in flowering period
B03995-208	Wheat, in flowering period
B03995-209	Wheat, in flowering period
B03995-210	Wheat, in flowering period
B03995-211	Wheat, in flowering period
B03995-212	Wheat, after mowing
B03995-213	Wheat, after mowing
B03995-218	Wheat straw, in sheaves, normal, black earth

25
WHEAT
Leaves

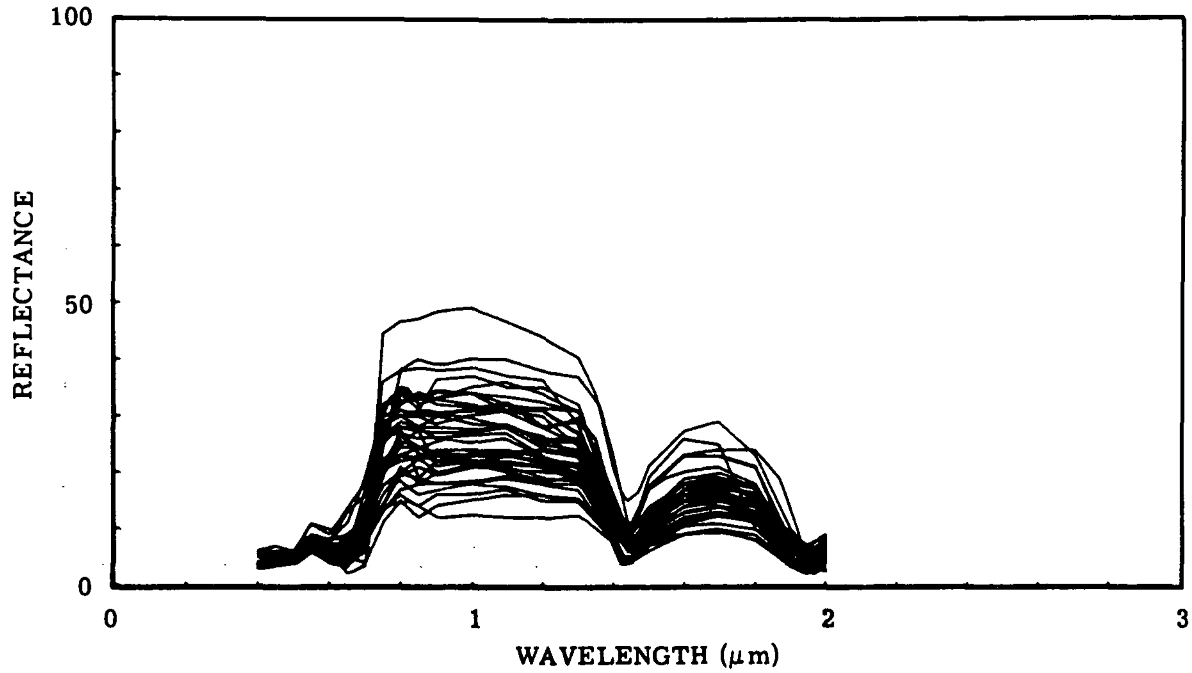


B01352-007	Leaves of wheat, inoculated, species undesignated
B01352-008	Leaves of wheat, susceptible, inoculated, excessive water
B01352-009	Leaves of wheat, susceptible, inoculated, low water
B01352-010	Middle wheat leaves, resistant, low water
B01352-011	Top wheat leaves, resistant, excessive water
B01352-012	Leaves of wheat, inoculated, species undesignated
B01352-025	Leaves of Blue Jacket wheat
B01352-028	Leaves of Blue Jacket wheat

26

WHEAT

Normal Stand, USAERDL Field Data



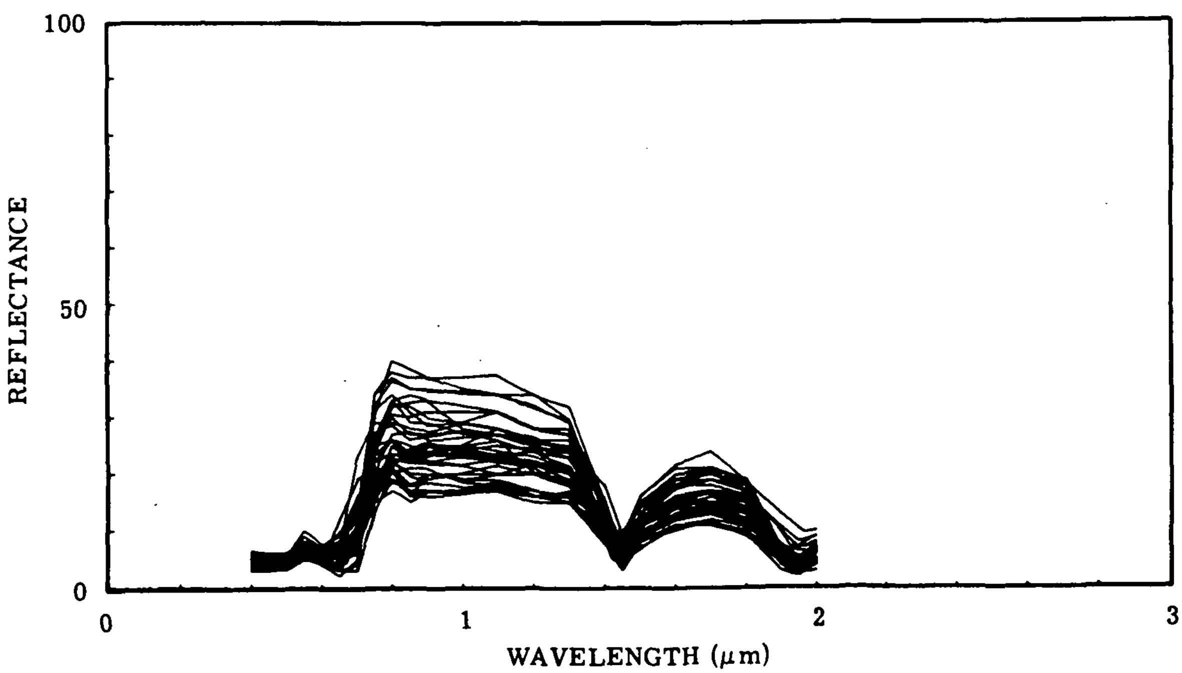
B01643-161	Wheat, mature, normal stand, low moisture
B01643-162	Wheat, mature, normal stand, low moisture
B01643-163	Wheat, mature, normal stand, low moisture
B01643-164	Wheat, mature, normal stand, high moisture
B01643-165	Wheat, mature, normal stand, high moisture
B01643-166	Wheat, mature, normal stand, high moisture
B01643-167	Wheat, mature, normal stand, low fertilizer
B01643-168	Wheat, mature, normal stand, low fertilizer
B01643-169	Wheat, mature, normal stand, low fertilizer
B01643-170	Wheat, mature, normal stand, high fertilizer
B01643-171	Wheat, mature, normal stand, high fertilizer
B01643-172	Wheat, mature, normal stand, high fertilizer
B01643-173	Wheat, mature, normal stand, light background
B01643-174	Wheat, mature, normal stand, light background
B01643-175	Wheat, mature, normal stand, light background
B01643-176	Wheat, mature, normal stand, normal background
B01643-177	Wheat, mature, normal stand, normal background

B01643-178	Wheat, mature, normal stand, normal background
B01643-179	Wheat, Thatcher, normal stand
B01643-180	Wheat, Thatcher, normal stand
B01643-228	Wheat, normal stand, low moisture
B01643-229	Wheat, normal stand, low moisture
B01643-230	Wheat, normal stand, low moisture
B01643-231	Wheat, normal stand, high moisture
B01643-232	Wheat, normal stand, high moisture
B01643-233	Wheat, normal stand, high moisture
B01643-234	Wheat, normal stand, low fertilizer
B01643-235	Wheat, normal stand, low fertilizer
B01643-237	Wheat, normal stand, high fertilizer
B01643-238	Wheat, normal stand, high fertilizer
B01643-239	Wheat, normal stand, high fertilizer
B01643-240	Wheat, normal stand, light background
B01643-241	Wheat, normal stand, light background
B01643-242	Wheat, normal stand, light background
B01643-243	Wheat, normal stand, normal background
B01643-244	Wheat, normal stand, normal background
B01643-245	Wheat, normal stand, normal background

27

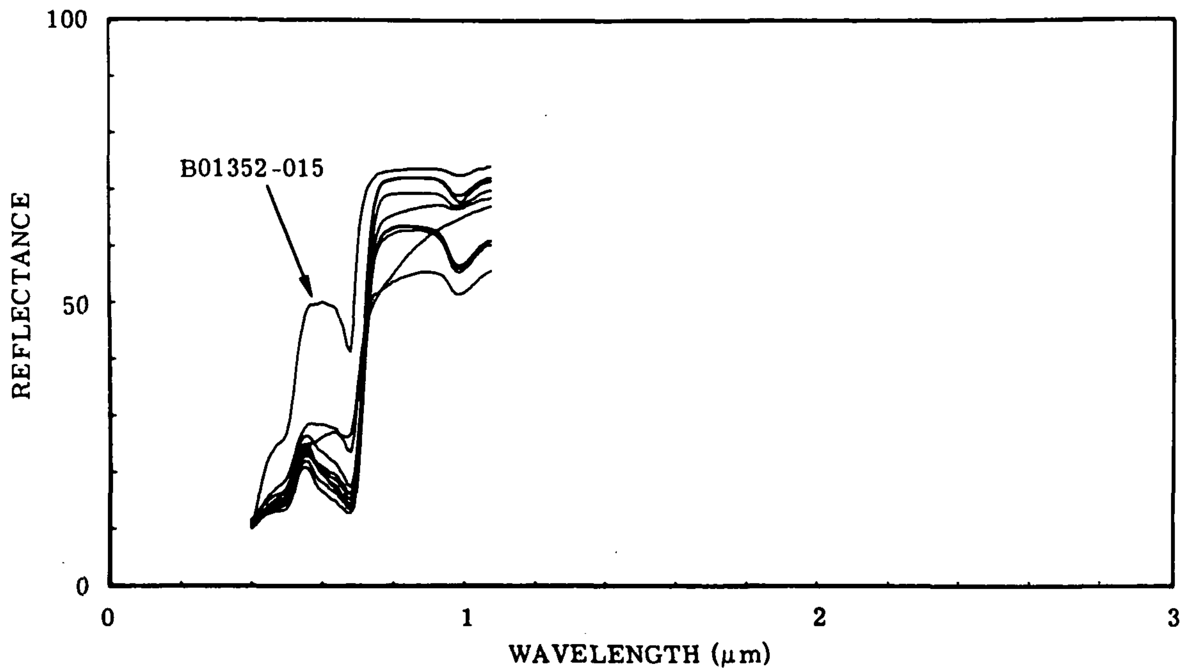
WHEAT

Thin Stand, USAERDL Field Data



B01643-144	Wheat, mature, thin stand, low moisture
B01643-145	Wheat, mature, thin stand, low moisture
B01643-146	Wheat, mature, thin stand, low moisture
B01643-147	Wheat, mature, thin stand, high moisture
B01643-148	Wheat, mature, thin stand, high moisture
B01643-149	Wheat, mature, thin stand, low fertilizer
B01643-150	Wheat, mature, thin stand, low fertilizer
B01643-151	Wheat, mature, thin stand, low fertilizer
B01643-152	Wheat, mature, thin stand, high fertilizer
B01643-153	Wheat, mature, thin stand, high fertilizer
B01643-154	Wheat, mature, thin stand, high fertilizer
B01643-155	Wheat, mature, thin stand, light background
B01643-156	Wheat, mature, thin stand, light background
B01643-157	Wheat, mature, thin stand, light background
B01643-158	Wheat, mature, thin stand, normal background
B01643-159	Wheat, mature, thin stand, normal background
B01643-160	Wheat, mature, thin stand, normal background
B01643-181	Wheat, Thatcher, thin stand
B01643-211	Wheat, thin stand, low moisture
B01643-212	Wheat, thin stand, low moisture
B01643-213	Wheat, thin stand, high moisture
B01643-214	Wheat, thin stand, high moisture
B01643-215	Wheat, thin stand, high moisture
B01643-216	Wheat, thin stand, low fertilizer
B01643-217	Wheat, thin stand, low fertilizer
B01643-218	Wheat, thin stand, low fertilizer
B01643-219	Wheat, thin stand, high fertilizer
B01643-220	Wheat, thin stand, high fertilizer
B01643-221	Wheat, thin stand, high fertilizer
B01643-222	Wheat, thin stand, light background
B01643-223	Wheat, thin stand, light background
B01643-224	Wheat, thin stand, light background
B01643-225	Wheat, thin stand, normal background
B01643-226	Wheat, thin stand, normal background
B01643-227	Wheat, thin stand, normal background

28
DISEASED WHEAT

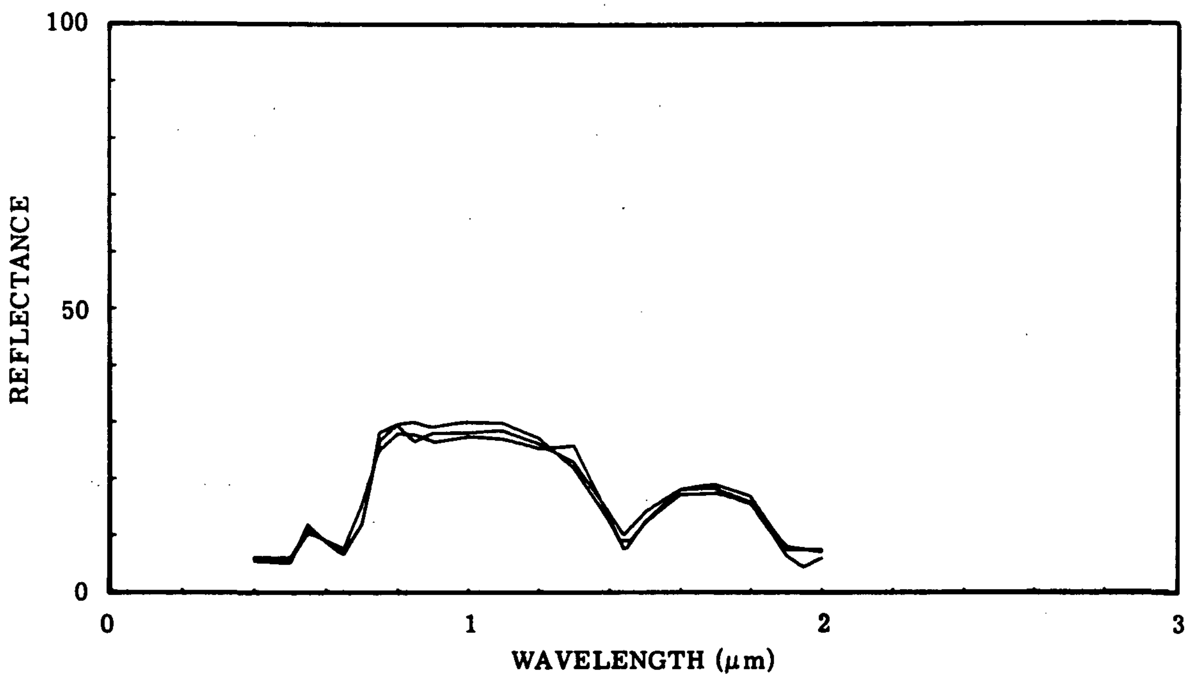


B01352-015	Leaves of Westar wheat, high rust severity
B01352-016	Heads of Westar wheat, high rust severity
B01352-017	Stalks of Westar wheat, high rust severity
B01352-018	Leaves of Westar wheat, low rust severity
B01352-019	Heads of Westar wheat, low rust severity
B01352-020	Stalks of Westar wheat, low rust severity
B01352-021	Heads of Wichita wheat, high rust severity
B01352-022	Stalks of Wichita wheat, high rust severity
B01352-023	Heads of Wichita wheat, low rust severity
B01352-024	Stalks of Wichita wheat, low rust severity

29

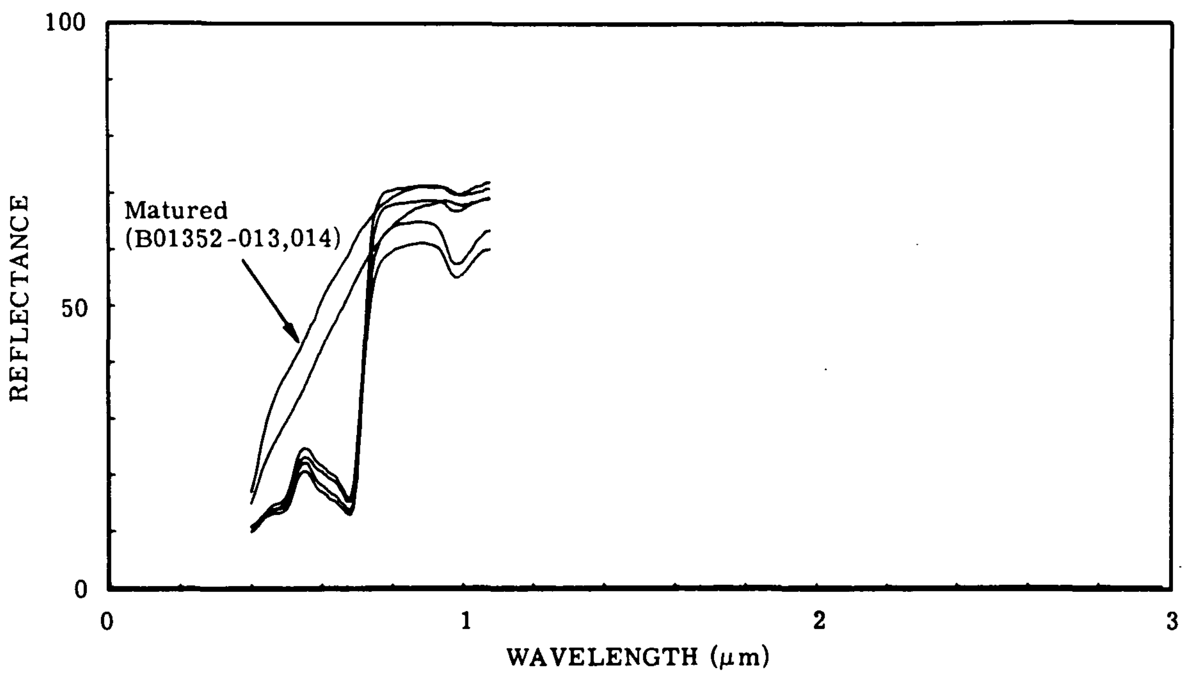
DISEASED WHEAT

USAERDL Field Data



B01643-112	Wheat, with black stem rust
B01643-113	Wheat, with black stem rust
B01643-114	Wheat, with black stem rust

30
WHEAT
Heads and Stalks

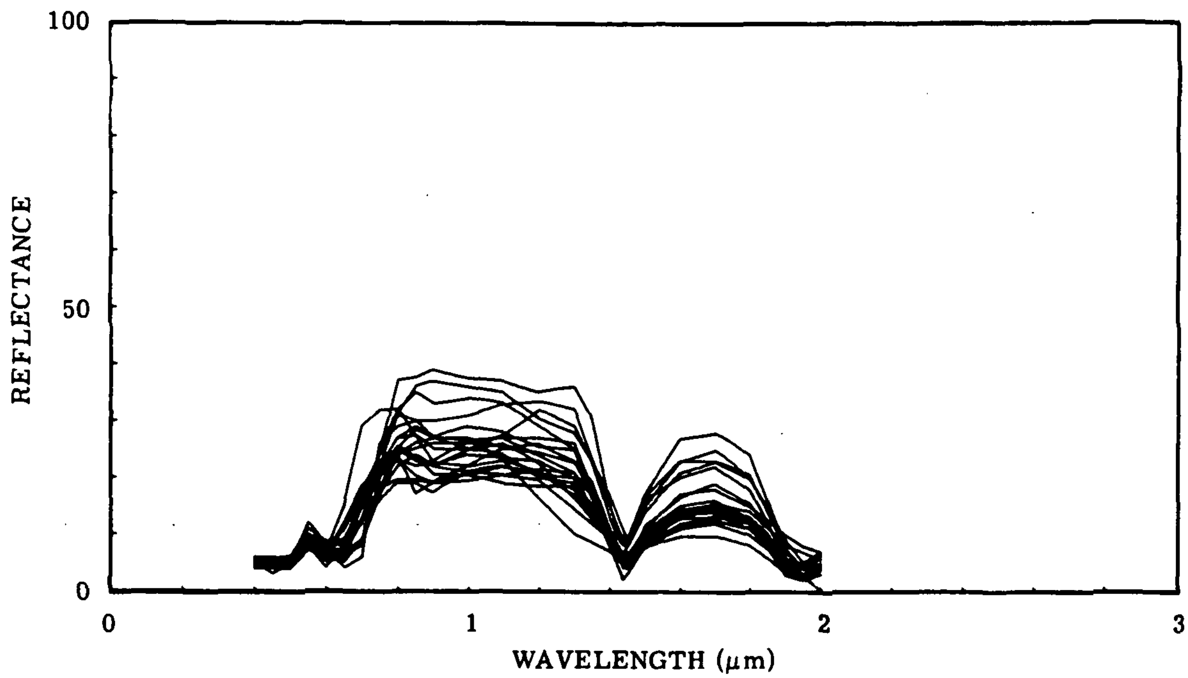


B01352-013	Mature wheat heads, inoculated
B01352-014	Mature wheat heads, inoculated
B01352-026	Heads of Blue Jacket wheat
B01352-027	Stalks of Blue Jacket wheat
B01352-029	Heads of Blue Jacket wheat
B01352-030	Stalks of Blue Jacket wheat

31

WHEAT

Seedling Stage, USAERDL Field Data



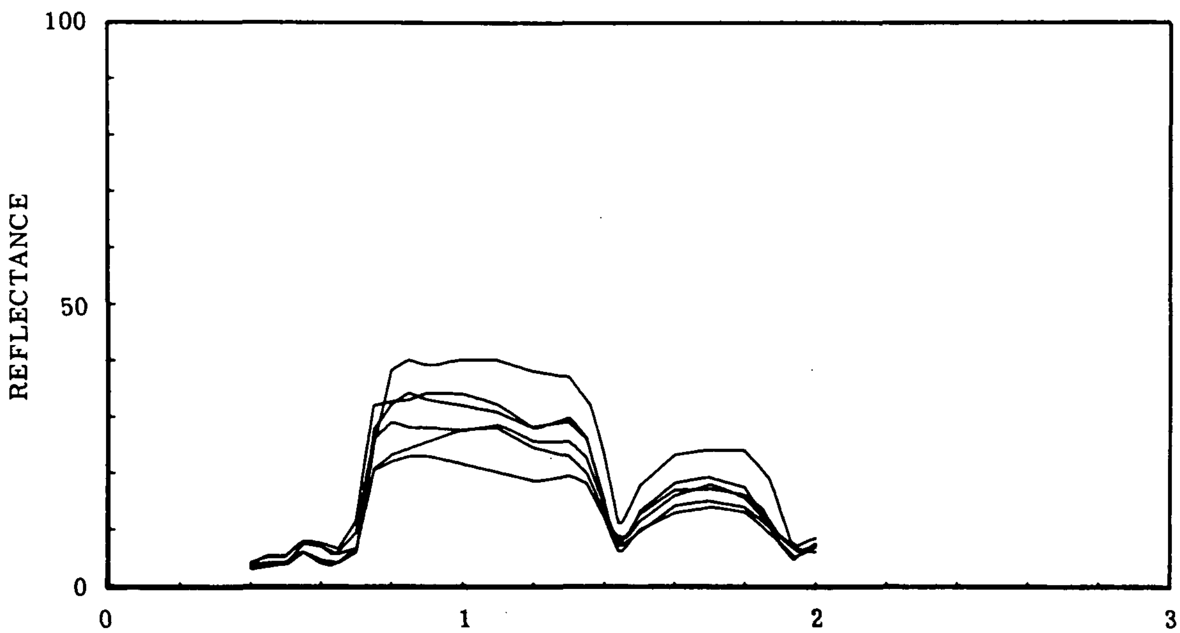
B01643-191	Wheat, seedling stage, normal stand, low moisture
B01643-192	Wheat, seedling stage, normal stand, low moisture
B01643-193	Wheat, seedling stage, normal stand, low moisture
B01643-194	Wheat, seedling stage, normal stand, high moisture
B01643-195	Wheat, seedling stage, normal stand, high moisture
B01643-196	Wheat, seedling stage, normal stand, high moisture
B01643-197	Wheat, seedling stage, normal stand, low fertilizer
B01643-198	Wheat, seedling stage, normal stand, low fertilizer
B01643-199	Wheat, seedling stage, normal stand, low fertilizer
B01643-200	Wheat, seedling stage, normal stand, high fertilizer
B01643-201	Wheat, seedling stage, normal stand, high fertilizer
B01643-202	Wheat, seedling stage, normal stand, high fertilizer
B01643-203	Wheat, seedling stage, normal stand, light background
B01643-204	Wheat, seedling stage, normal stand, light background
B01643-205	Wheat, seedling stage, normal stand, light background
B01643-206	Wheat, seedling stage, normal stand, normal background
B01643-207	Wheat, seedling stage, normal stand, normal background
B01643-208	Wheat, seedling stage, normal stand, normal background

B01643-209	Wheat, seedling stage, normal stand, normal background
B01643-210	Wheat, seedling stage, normal stand, normal background

32

WHEAT

Background Study, USAERDL Field Data

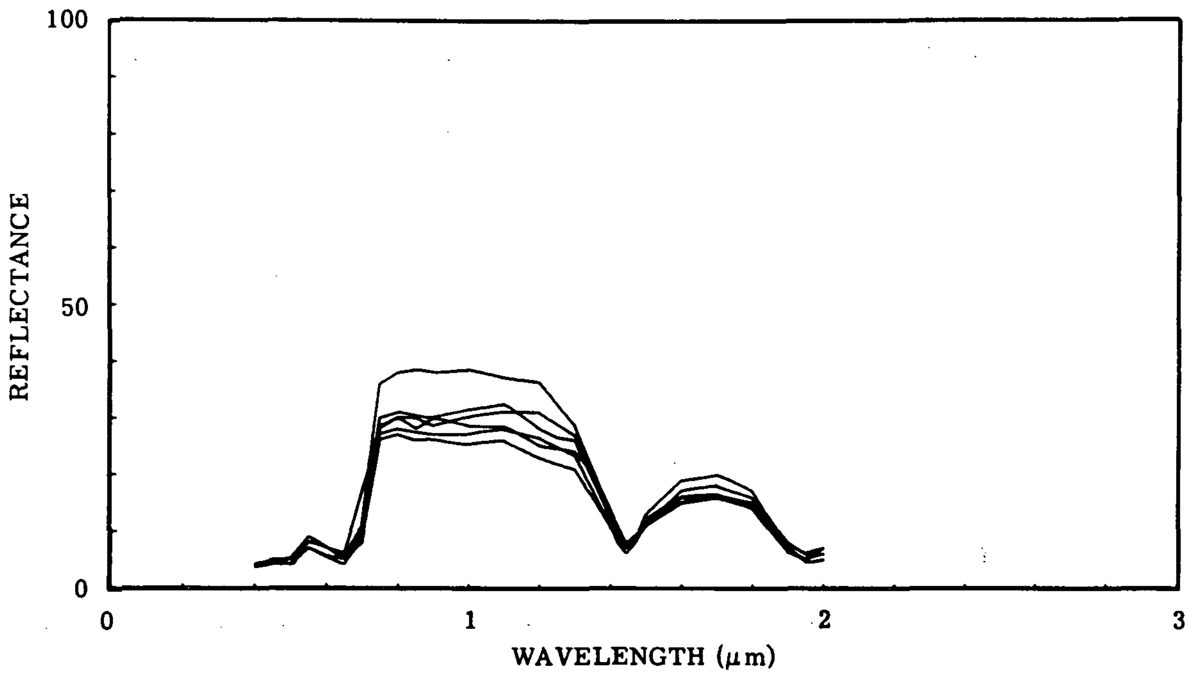


B01643-173	Wheat, mature, normal stand, light background
B01643-174	Wheat, mature, normal stand, light background
B01643-175	Wheat, mature, normal stand, light background
B01643-176	Wheat, mature, normal stand, normal background
B01643-177	Wheat, mature, normal stand, normal background
B01643-178	Wheat, mature, normal stand, normal background

33

WHEAT

Moisture Study, USAERDL Field Data

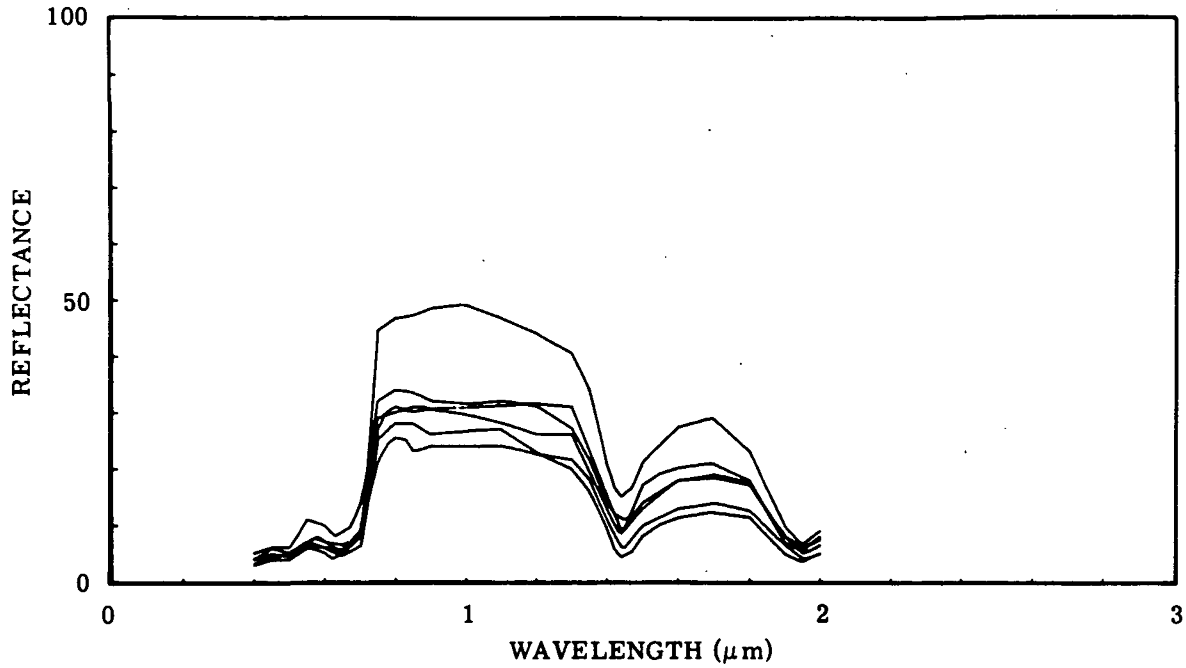


B01643-161	Wheat, mature, normal stand, low moisture
B01643-162	Wheat, mature, normal stand, low moisture
B01643-163	Wheat, mature, normal stand, low moisture
B01643-164	Wheat, mature, normal stand, high moisture
B01643-165	Wheat, mature, normal stand, high moisture
B01643-166	Wheat, mature, normal stand, high moisture

34

WHEAT

Fertilizer Study, USAERDL Field Data

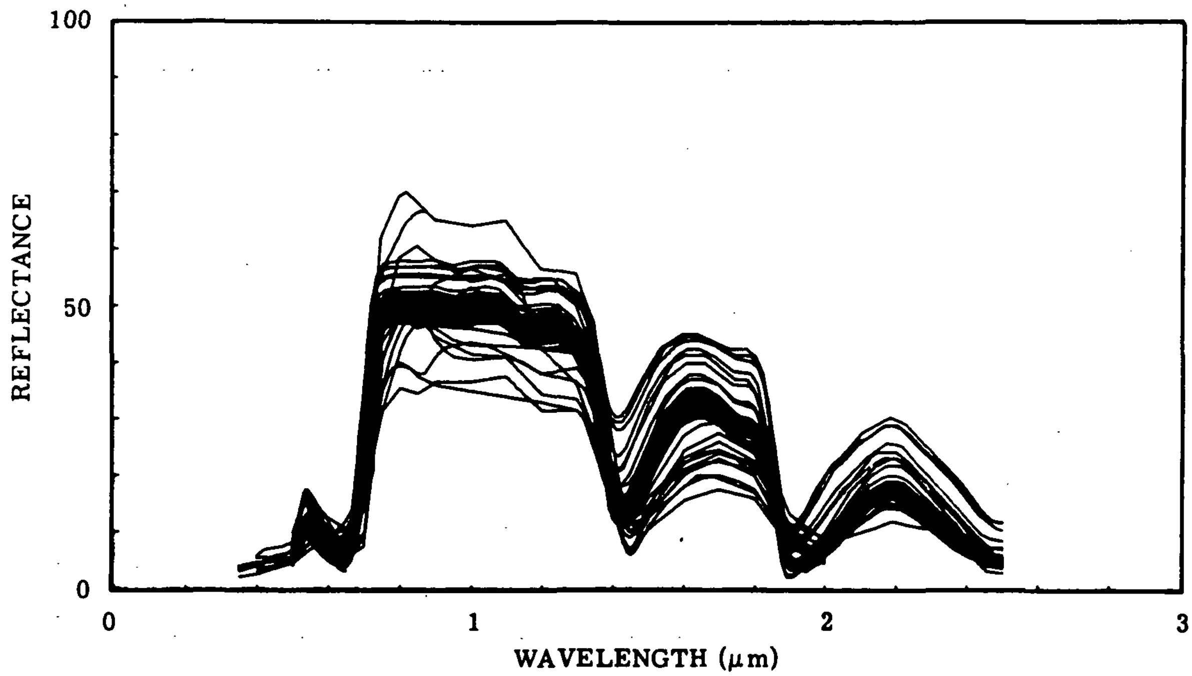


B01643-167	Wheat, mature, normal stand, low fertilizer
B01643-168	Wheat, mature, normal stand, low fertilizer
B01643-169	Wheat, mature, normal stand, low fertilizer
B01643-170	Wheat, mature, normal stand, high fertilizer
B01643-171	Wheat, mature, normal stand, high fertilizer
B01643-172	Wheat, mature, normal stand, high fertilizer

C 2

35

COTTON REFLECTANCE

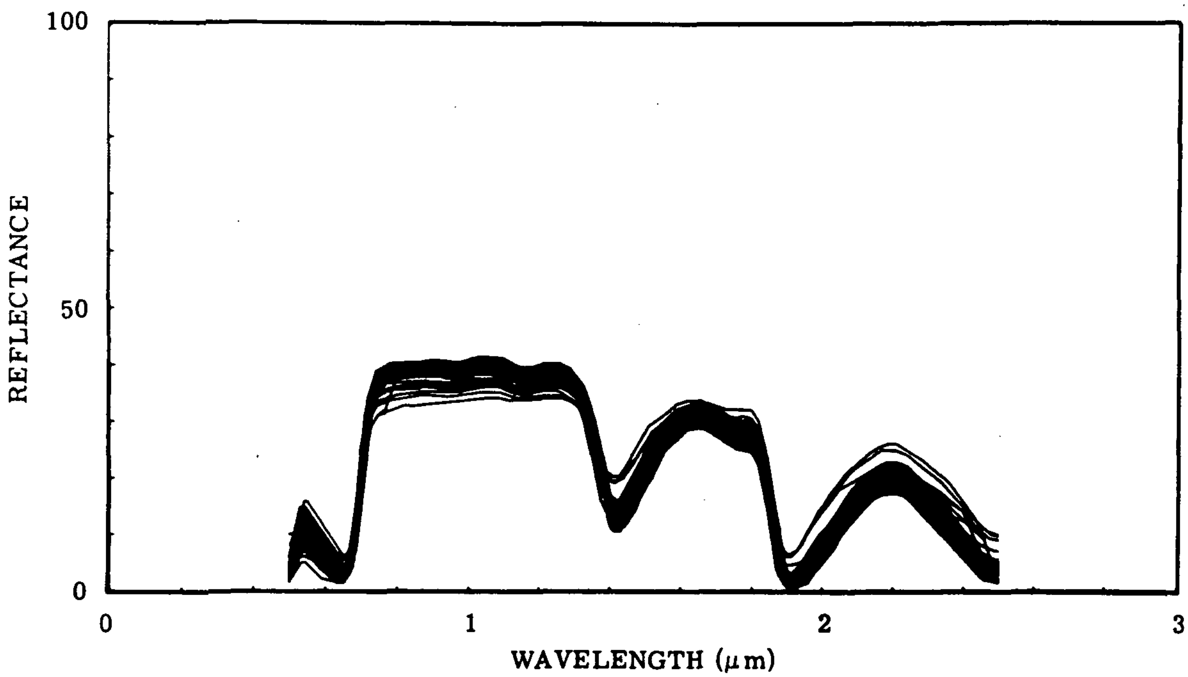


B01643-036	Cotton, normal stand
B01643-037	Cotton, normal stand
B01643-038	Cotton, normal stand
B01643-039	Cotton, normal stand, weedy
B01643-040	Cotton, normal stand, weedy
B01643-041	Cotton, normal stand, weedy
B01643-042	Cotton, thin stand
B01643-043	Cotton, thin stand
B01643-044	Cotton, thin stand
B01643-045	Cotton, normal stand
B01643-046	Cotton, normal stand
B01643-047	Cotton, normal stand
B03995-221	Cotton, coated with dust before flowering
B04616-001	Cotton leaf, 81.9% water in leaf
B04616-003	Cotton leaf, 80.0% water in leaf
B04616-005	Cotton leaf, 77.1% water in leaf
B04616-007	Cotton leaf, 66.2% water in leaf
B04616-008	Cotton leaf, 74.6% water in leaf
B04616-011	Cotton leaf, 82.4% water in leaf

B04616-013	Cotton leaf, 80.7% water in leaf
B04616-015	Cotton leaf, 78.0% water in leaf
B04616-017	Cotton leaf, 75.6% water in leaf
B04616-018	Cotton leaf, 67.8% water in leaf
B04616-021	Cotton leaf, 80.3% water in leaf
B04616-023	Cotton leaf, 76.9% water in leaf
B04616-025	Cotton leaf, 82.5% water in leaf
B04616-027	Cotton leaf, 56.3% water in leaf
B04616-028	Cotton leaf, 73.1% water in leaf
B04616-031	Cotton leaf, 82.3% water in leaf
B04616-033	Cotton leaf, 80.2% water in leaf
B04616-035	Cotton leaf, 76.8% water in leaf
B04616-037	Cotton leaf, 49.4% water in leaf
B04616-038	Cotton leaf, 71.6% water in leaf
B04616-041	Cotton leaf, 84.0% water in leaf
B04616-043	Cotton leaf, 83.0% water in leaf
B04616-045	Cotton leaf, 81.2% water in leaf
B04616-047	Cotton leaf, 68.4% water in leaf
B04616-048	Cotton leaf, 78.5% water in leaf
B04616-051	Cotton leaf, 78.9% water in leaf
B04616-053	Cotton leaf, 76.9% water in leaf
B04616-055	Cotton leaf, 73.6% water in leaf
B04616-057	Cotton leaf, 58.5% water in leaf
B04616-058	Cotton leaf, 69.8% water in leaf
B04616-061	Cotton leaf, 82.7% water in leaf
B04616-063	Cotton leaf, 81.3% water in leaf
B04616-065	Cotton leaf, 78.6% water in leaf
B04616-067	Cotton leaf, 62.0% water in leaf
B04616-068	Cotton leaf, 75.3% water in leaf
B04616-071	Cotton leaf, 80.6% water in leaf
B04616-073	Cotton leaf, 78.9% water in leaf
B04616-075	Cotton leaf, 76.2% water in leaf
B04616-077	Cotton leaf, 60.7% water in leaf
B04616-078	Cotton leaf, 72.8% water in leaf

36

COTTON-TRANSMITT.

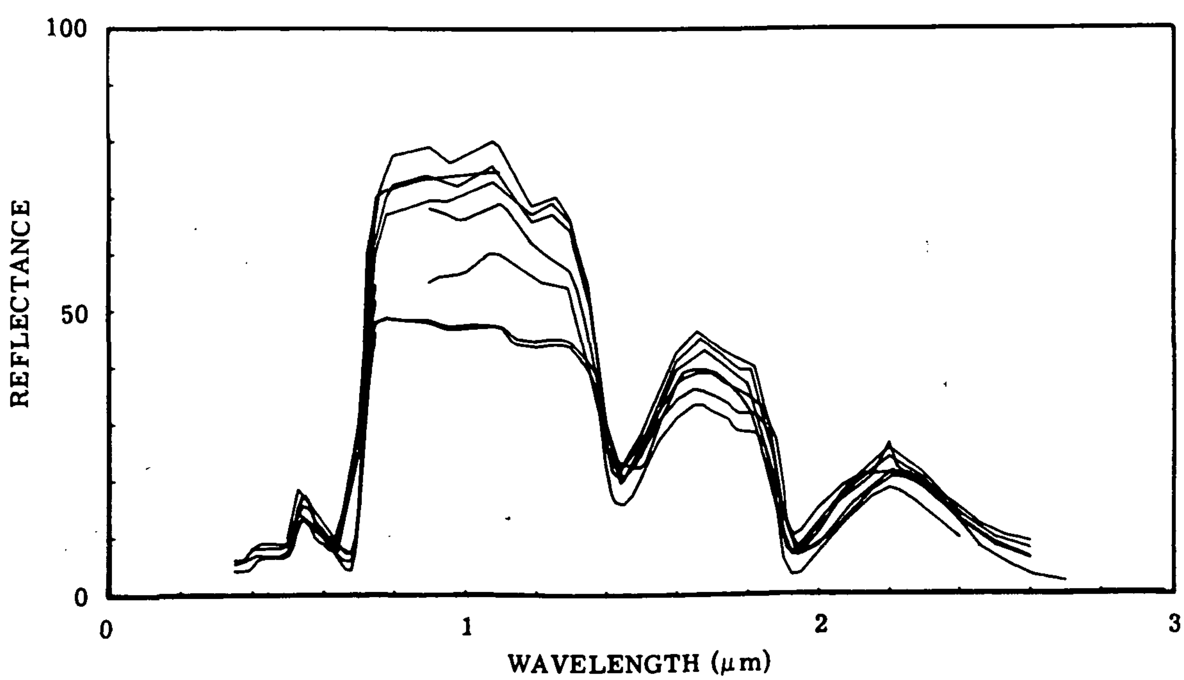


B04616-002	Cotton leaf, 81.9% water in leaf
B04616-004	Cotton leaf, 80.0% water in leaf
B04616-006	Cotton leaf, 77.1% water in leaf
B04616-009	Cotton leaf, 74.6% water in leaf
B04616-010	Cotton leaf, 66.2% water in leaf
B04616-012	Cotton leaf, 82.4% water in leaf
B04616-014	Cotton leaf, 80.7% water in leaf
B04616-016	Cotton leaf, 78.0% water in leaf
B04616-019	Cotton leaf, 67.8% water in leaf
B04616-020	Cotton leaf, 75.6% water in leaf
B04616-022	Cotton leaf, 80.3% water in leaf
B04616-024	Cotton leaf, 76.9% water in leaf
B04616-026	Cotton leaf, 82.5% water in leaf
B04616-029	Cotton leaf, 73.1% water in leaf
B04616-030	Cotton leaf, 56.3% water in leaf
B04616-032	Cotton leaf, 82.3% water in leaf
B04616-034	Cotton leaf, 80.2% water in leaf
B04616-036	Cotton leaf, 76.8% water in leaf
B04616-039	Cotton leaf, 71.6% water in leaf

B04616-040	Cotton leaf, 49.4% water in leaf
B04616-042	Cotton leaf, 84.0% water in leaf
B04616-044	Cotton leaf, 83.0% water in leaf
B04616-046	Cotton leaf, 81.2% water in leaf
B04616-049	Cotton leaf, 78.5% water in leaf
B04616-050	Cotton leaf, 68.4% water in leaf
B04616-052	Cotton leaf, 78.9% water in leaf
B04616-054	Cotton leaf, 76.9% water in leaf
B04616-056	Cotton leaf, 73.6% water in leaf
B04616-059	Cotton leaf, 69.8% water in leaf
B04616-060	Cotton leaf, 58.5% water in leaf
B04616-062	Cotton leaf, 82.7% water in leaf
B04616-064	Cotton leaf, 81.3% water in leaf
B04616-066	Cotton leaf, 78.6% water in leaf
B04616-069	Cotton leaf, 75.3% water in leaf
B04616-070	Cotton leaf, 62.0% water in leaf
B04616-072	Cotton leaf, 80.6% water in leaf
B04616-074	Cotton leaf, 78.9% water in leaf
B04616-076	Cotton leaf, 76.2% water in leaf
B04616-079	Cotton leaf, 72.8% water in leaf
B04616-080	Cotton leaf, 60.7% water in leaf

37

GRASS

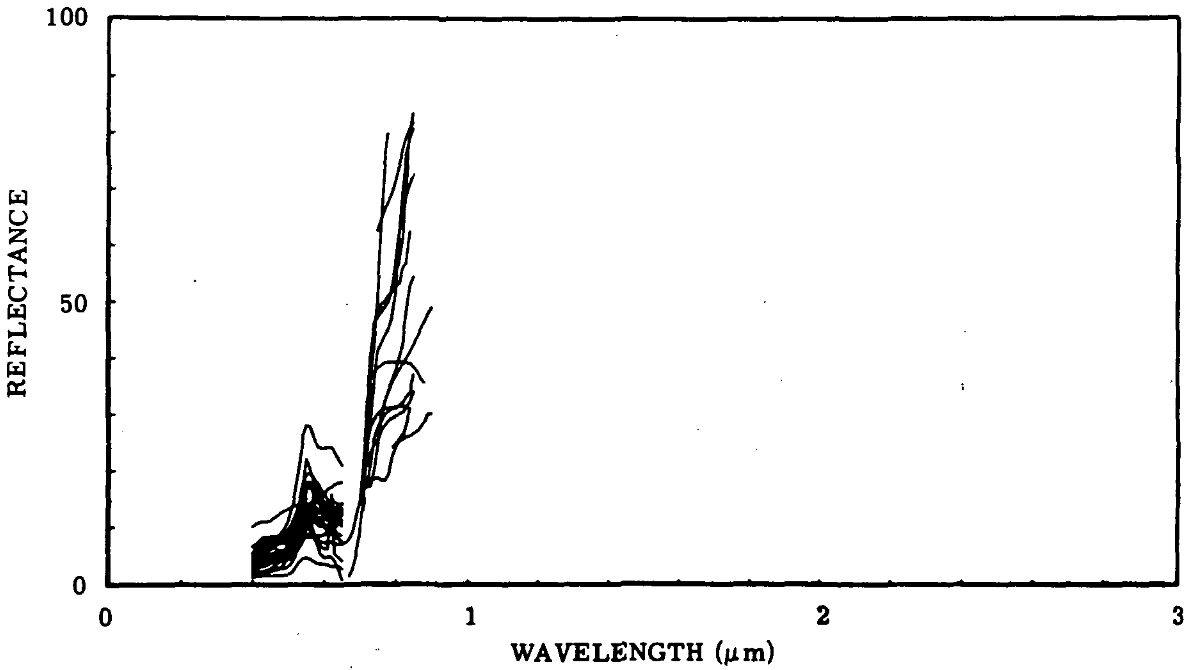


B02418-342	Visible, orchard grass, green, normal, healthy
B02418-343	IR, orchard grass, green, normal, healthy
B02418-344	Visible, orchard grass, green, normal, healthy
B02418-345	IR, orchard grass, green, normal, healthy
B02418-346	Visible, orchard grass, green, normal, healthy
B02418-347	IR, orchard grass, green, normal, healthy
B00829-099	Grass (Agrostis palustris), top, old foliage
B00829-103	Bermuda grass
B20000-221	Grass blades, upper leaf surface
B20000-222	Grass blades, lower leaf surface

38

GRASS

Krinov Field Data



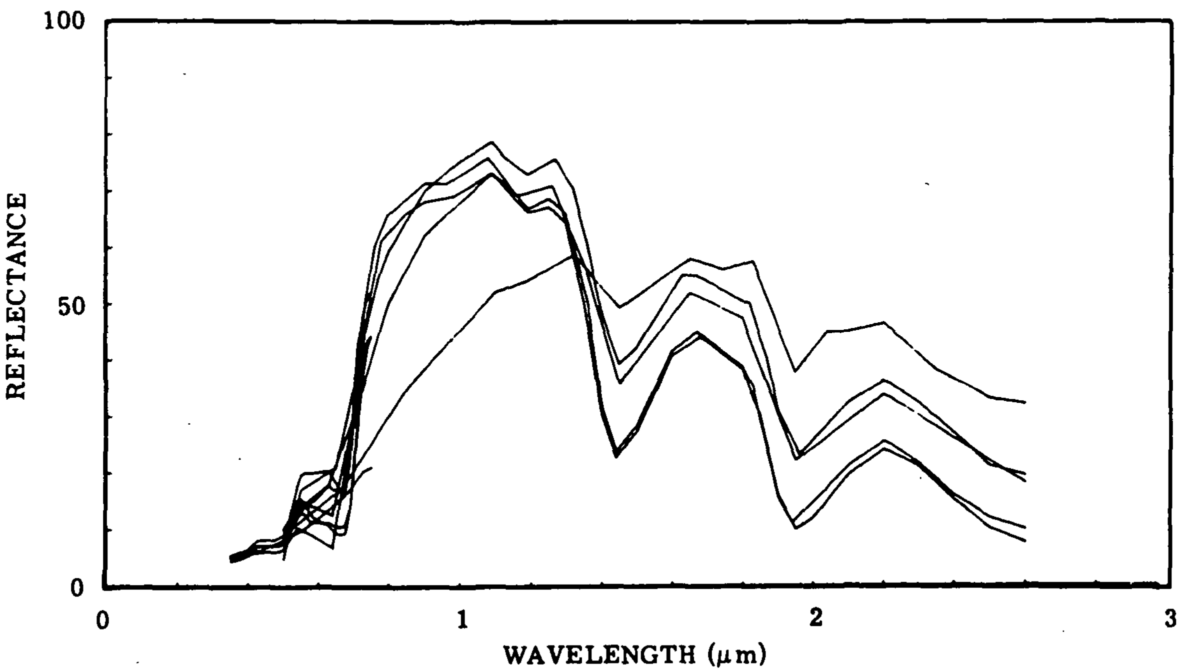
B03995-070	Turf hillocks, covered with grass (European blueberry, etc.) in the summer, normal
B03995-071	Edge of ravine, covered with sparse grass almost dry, beginning of autumn, normal
B03995-072	Edges of river bank, covered with sparse grass almost dry, beginning of autumn, normal
B03995-073	Alpine meadow, on mountain tops, covered with sparse grass, dried, beginning of autumn, normal
B03995-074	Alpine meadow, on mountain tops, covered with sparse grass, dried, mowed, beginning of autumn, normal

B03995-082	Meadow with clover and timothy, dense growth, with flowers, midsummer
B03995-083	Meadow with clover and timothy, dense growth, with flowers, midsummer
B03995-084	Meadow with clover and timothy, dense growth, with flowers, midsummer
B03995-085	Meadow with clover and timothy, mowed
B03995-086	Meadow with clover and timothy, mowed, wet after rain, cloudy sky
B03995-087	Meadow with clover and timothy, mowed, wet after rain, cloudy sky
B03995-088	Meadow with clover and timothy, mowed, wet after rain, cloudy sky
B03995-089	Meadow with crow foot, dense grass with abundant flowers
B03995-090	Meadow with crow foot, dense grass with abundant flowers
B03995-091	Meadow with crow foot, dense grass with abundant flowers
B03995-092	Sedge meadow, dense grass in midsummer
B03995-093	Meadow with daisies, in the period of abundant bloom
B03995-094	Lush meadow (flood land), with lush dense grass at the beginning of autumn, before mowing, normal

39

GRASS

Diseased

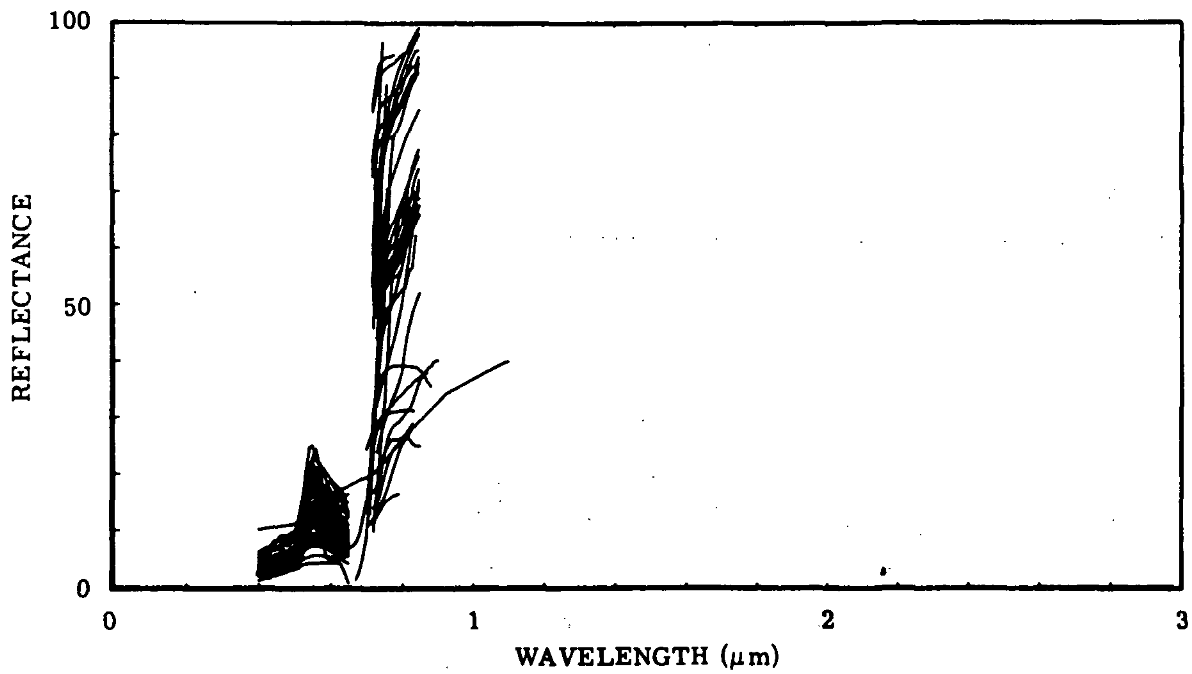


B02418-348	Visible, orchard grass, fall, rust infected (small brown spots) top of leaf
B02418-349	IR, orchard grass, fall, rust infected (small brown spots) top of leaf
B02418-350	Visible, orchard grass, fall, rust infected (small brown spots) top of leaf
B02418-351	IR, orchard grass, fall, rust infected (small brown spots) top of leaf
B02418-352	Visible, orchard grass, fall, rust infected (small brown spots) top of leaf
B02418-353	IR, orchard grass, fall, rust infected (small brown spots) top of leaf
B02418-354	Visible, orchard grass, fall, rust infected (small brown spots) bottom of leaf
B02418-355	IR, orchard grass, fall, rust infected (small brown spots) bottom of leaf
B02418-356	Visible, orchard grass, dry, brown leaves, apparently rust infected
B02418-357	IR, orchard grass, dry, brown leaves, apparently rust infected

40

GRASS

Dying (Brown), Mostly Krinov Field Data



B01176-048	Grass, dead
B03995-095	Dry meadow, with dense short grass in midsummer, normal angle of sun 25°
B03995-096	Dry meadow, with dense short grass in midsummer
B03995-097	Dry meadow, with dense short grass in midsummer
B03995-098	Dry meadow, with dense short grass in midsummer
B03995-099	Dry meadow, with dense short grass in midsummer
B03995-100	Dry meadow, with dense short grass in midsummer
B03995-101	Dry meadow, with dense short grass in midsummer

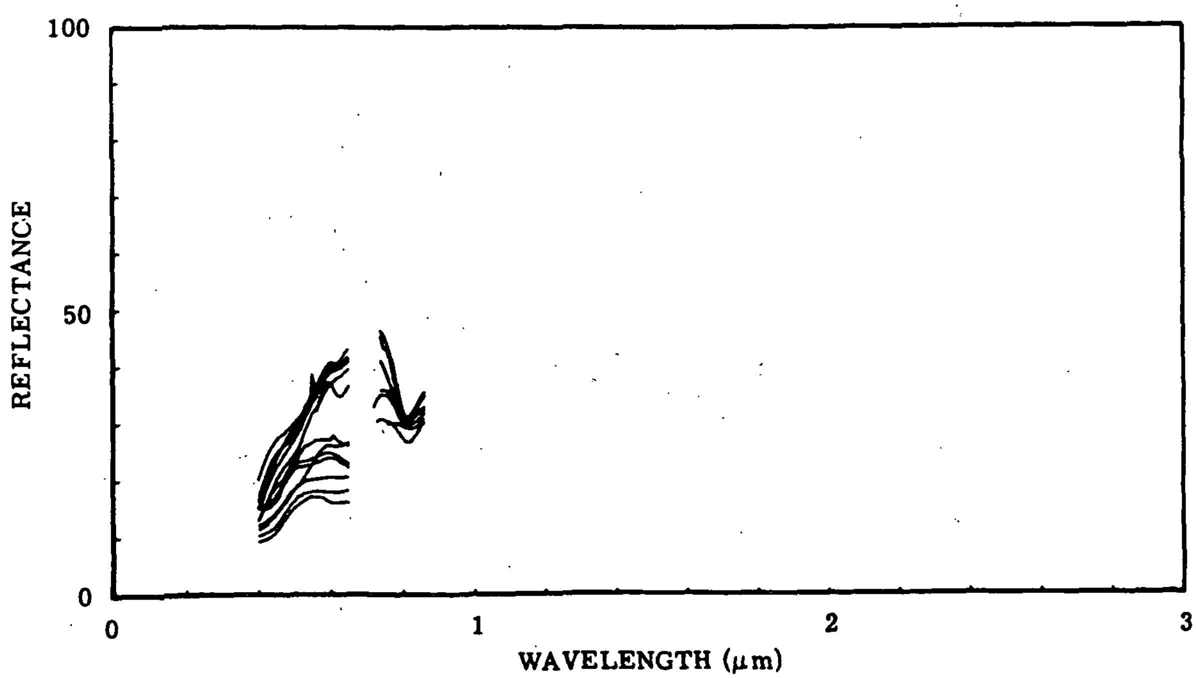
B03995-102	Dry meadow, with dense short grass in midsummer
B03995-103	Dry meadow, with dense short grass in midsummer
B03995-104	Dry meadow, with dense short grass in midsummer
B03995-105	Dry meadow, with dense short grass in midsummer
B03995-106	Dry meadow, with dense short grass in midsummer
B03995-107	Dry meadow, with dense short grass in midsummer
B03995-108	Dry meadow, with dense short grass in midsummer
B03995-109	Dry meadow, with dense short grass in midsummer
B03995-110	Dry meadow, with dense short grass in midsummer
B03995-111	Dry meadow, with dense short grass in midsummer
B03995-112	Dry meadow, with dense short grass in midsummer
B03995-113	Dry meadow, with dense short grass in midsummer
B03995-114	Dry meadow, with dense short grass in midsummer, normal, angle of sun = 45^{o}
B03995-115	Dry meadow, with dense short grass in midsummer
B03995-116	Dry meadow, with dense short grass in midsummer
B03995-117	Dry meadow, with dense short grass in midsummer
B03995-118	Dry meadow, with dense short grass in midsummer
B03995-119	Dry meadow, with dense short grass in midsummer
B03995-120	Dry meadow, with dense short grass in midsummer
B03995-121	Dry meadow, with dense short grass in midsummer
B03995-122	Dry meadow, with dense short grass in midsummer
B03995-123	Dry meadow, with dense short grass in midsummer
B03995-124	Dry meadow, with dense short grass in midsummer
B03995-125	Dry meadow, with dense short grass in midsummer
B03995-126	Dry meadow, with dense short grass in midsummer
B03995-127	Dry meadow, with dense short grass in midsummer
B03995-128	Dry meadow, with dense short grass in midsummer
B03995-129	Dry meadow, with dense short grass in midsummer
B03995-130	Dry meadow, with dense short grass in midsummer
B03995-131	Dry meadow, with dense short grass in midsummer
B03995-132	Dry meadow, with dense short grass in midsummer
B03995-133	Dry meadow, with dense short grass in midsummer
B03995-134	Dry meadow, with dense short grass in midsummer
B03995-135	Dry meadow, with sparse low grass, normal
B03995-136	Dry meadow, with sparse low grass
B03995-137	Dry meadow, with sparse low grass
B03995-138	Dry meadow, with dense low grass, normal

B03995-139	Dry meadow, with dense low grass
B03995-140	Dry meadow, with dense low grass
B03995-141	Dry meadow, with sparse dry grass on hills (early autumn) normal
B03995-142	Meadow, with dense but low grass (early autumn), aircraft altitude 300 miles
B03995-143	Meadow, with sparse grass, grazed, aircraft altitude 300 miles
B03995-146	Shallows of river (in high water), covered with grass
B03995-154	Mountain side, with low sparse grass, early autumn, normal
B03995-155	Virgin steppe, with low grass burnt by sun, early autumn cloudy sky, normal
B03995-156	Virgin steppe, with low grass burnt by sun, early autumn cloudy sky, angle = 30^{o}
B03995-157	Virgin steppe, with low grass burnt by the sun, early autumn, angle = 60^{o}
B03995-158	Virgin steppe, with low grass burnt by the sun, but fresher and wetter after rain, early autumn, cloudy sky, normal
B03995-159	Virgin steppe, with low grass burnt by the sun, but fresher and wetter after rain, early autumn, cloudy sky, angle = 30^{o}
B03995-160	Virgin steppe, with low grass burnt by the sun, but fresher and wetter after rain, early autumn, cloudy sky, angle = 60^{o}
B03995-161	Grass, near road, dusty, normal
B03995-162	Grass, young, green
B03995-163	Grass, last year's (dry), spring
B03995-164	Grass, summer green
B03995-167	Hillside, short grass, normal

41

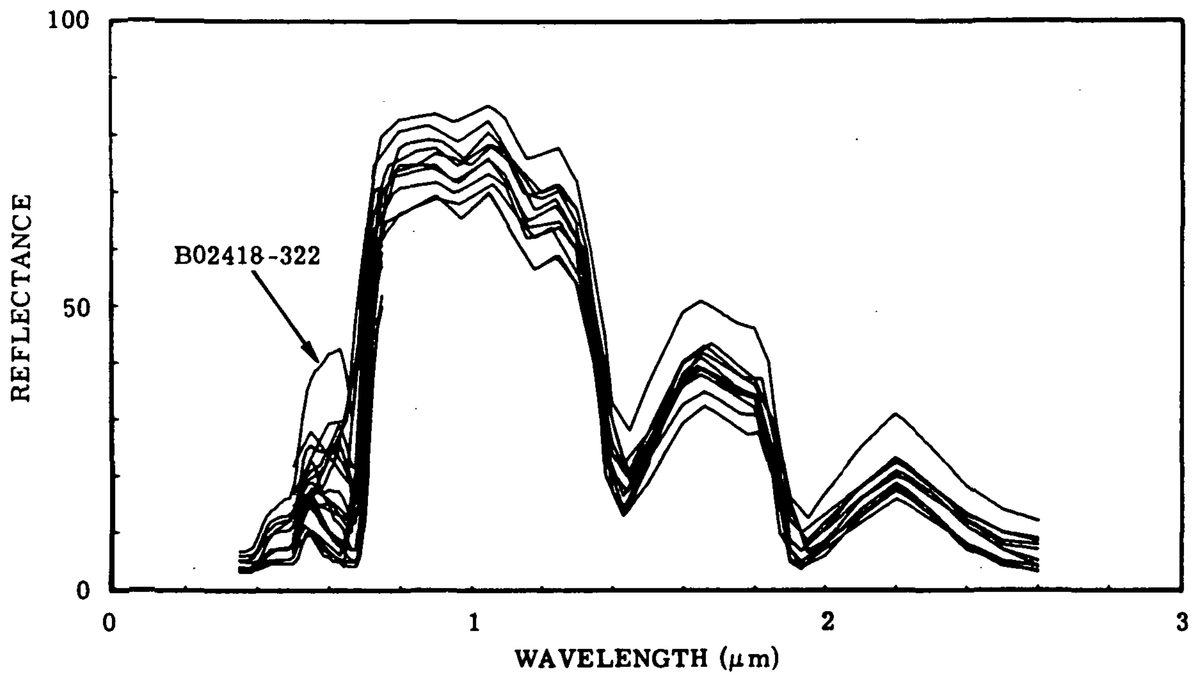
ILYAS

Krinov Field Data



B03995-056	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer, normal
B03995-057	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-058	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-059	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-060	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-061	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-062	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-063	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-064	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-065	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-066	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-067	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer
B03995-068	Ilyas, sparse and dry (yellowish) grass on sand at the end of summer

42
ALFALFA



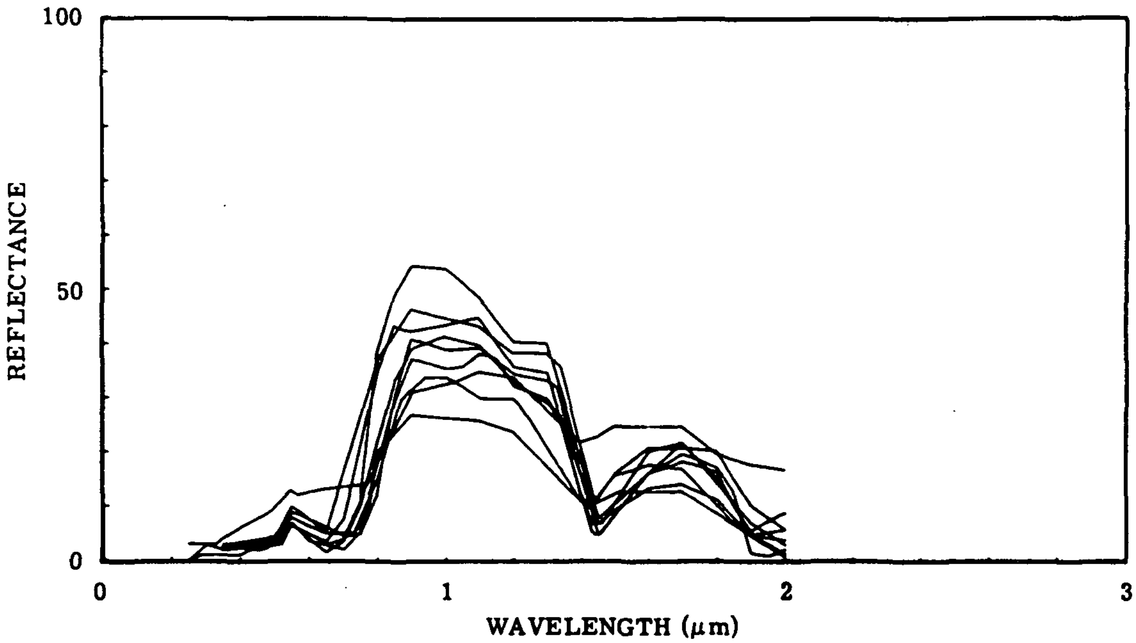
B02418-306	Visible, alfalfa, yellow-red leaves
B02418-307	IR, alfalfa, yellow-red leaves
B02418-308	Visible, alfalfa, purplish green
B02418-309	IR, alfalfa, purplish green
B02418-310	Visible, alfalfa, yellowish, frost damage
B02418-311	IR, alfalfa, yellowish, frost damage
B02418-312	Visible, alfalfa, green, healthy normal leaf
B02418-313	IR, alfalfa, green, healthy naormal leaf
B02418-314	Visible, alfalfa, greenish purple yellow, small leaves
B02418-315	IR, alfalfa, greenish purple yellow, small leaves
B02418-316	Visible, alfalfa, light green, normal healthy leaves
B02418-317	IR, alfalfa, light green, normal healthy leaves
B02418-318	Visible, alfalfa, green, normal healthy leaves
B02418-319	IR, alfalfa, green, normal healthy leaves
B02418-320	Visible, alfalfa, green, normal healthy leaves
B02418-321	IR, alfalfa, green, normal healthy leaves
B02418-322	Visible, alfalfa, yellowish, normal healthy leaves
B02418-323	IR, alfalfa, yellowish, normal healthy leaves
B02418-324	Visible, alfalfa, purplish, normal healthy leaves

B02418-325	IR, alfalfa, purplish, normal healthy leaves
B02418-326	Visible, alfalfa, purplish, normal healthy leaves
B02418-327	IR, alfalfa, purplish, normal healthy leaves

43

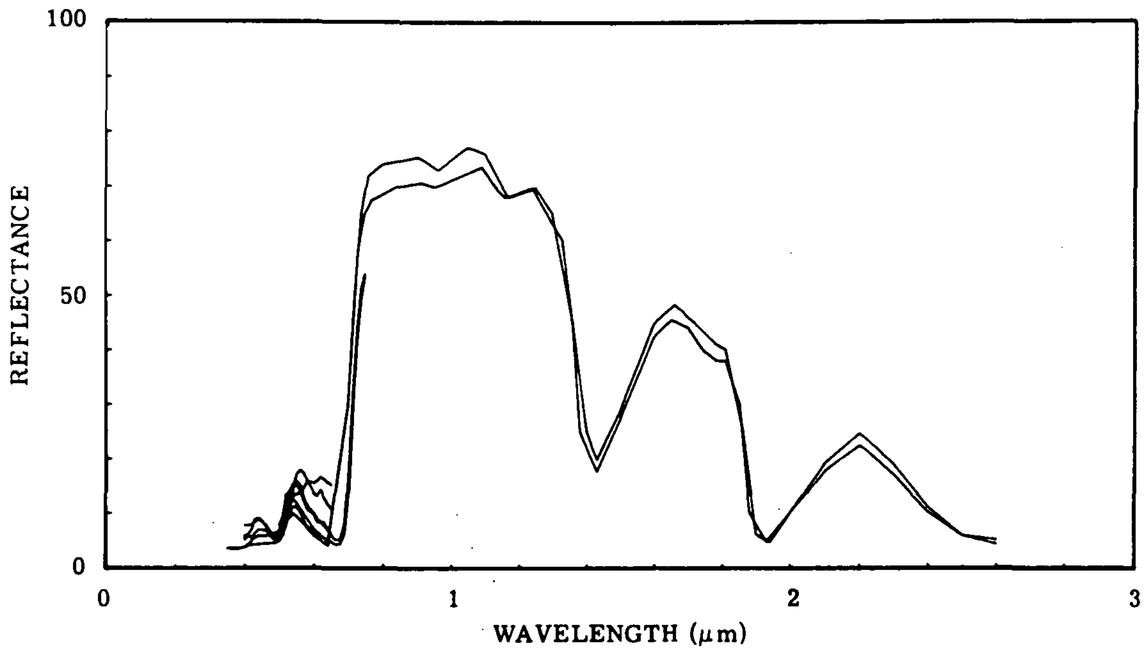
ALFALFA

USAERDL Field Data



B01337-028	Alfalfa
B01337-029	Alfalfa, 12 in.
B01337-030	Alfalfa, 22 in.
B03258-005	Alfalfa
B01643-091	Alfalfa, normal stand
B01643-092	Alfalfa, normal stand
B01643-093	Alfalfa, normal stand
B01643-094	Alfalfa, normal stand, weedy
B01643-095	Alfalfa, normal stand, weedy
B01643-096	Alfalfa, normal stand, weedy

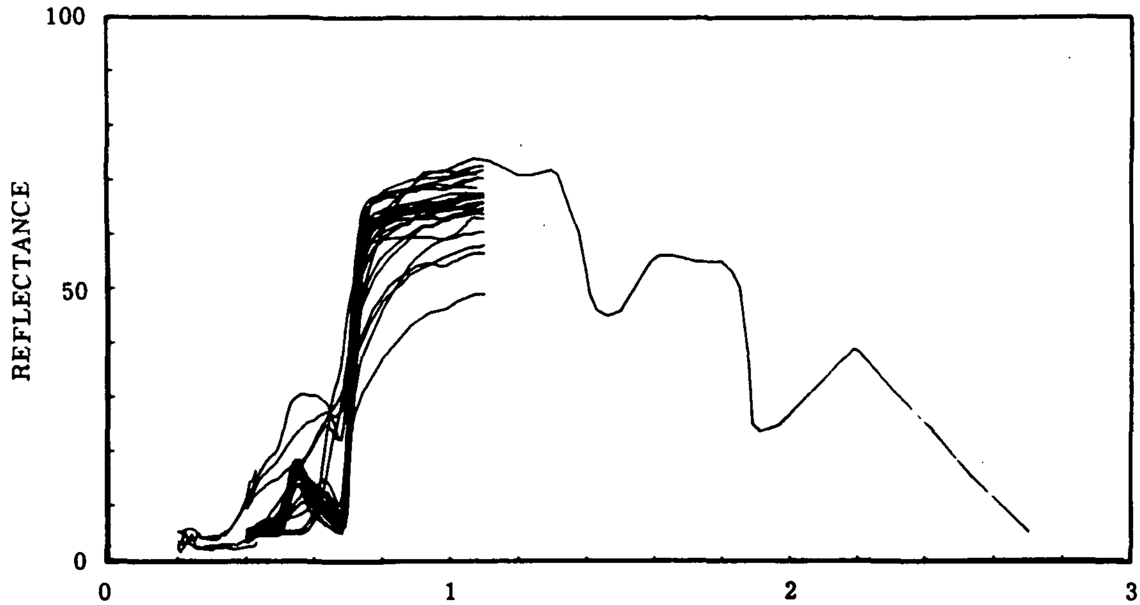
44
CLOVER



B02418-328	Visible, red clover
B02418-329	IR, red clover
B02418-330	Visible, white clover
B02418-331	IR, white clover
B03995-181	White clover, flowering period
B03995-182	Red clover, flowering period
B03995-183	Red clover, young grass after first mowing, angle = 90°

45

DOGWOOD

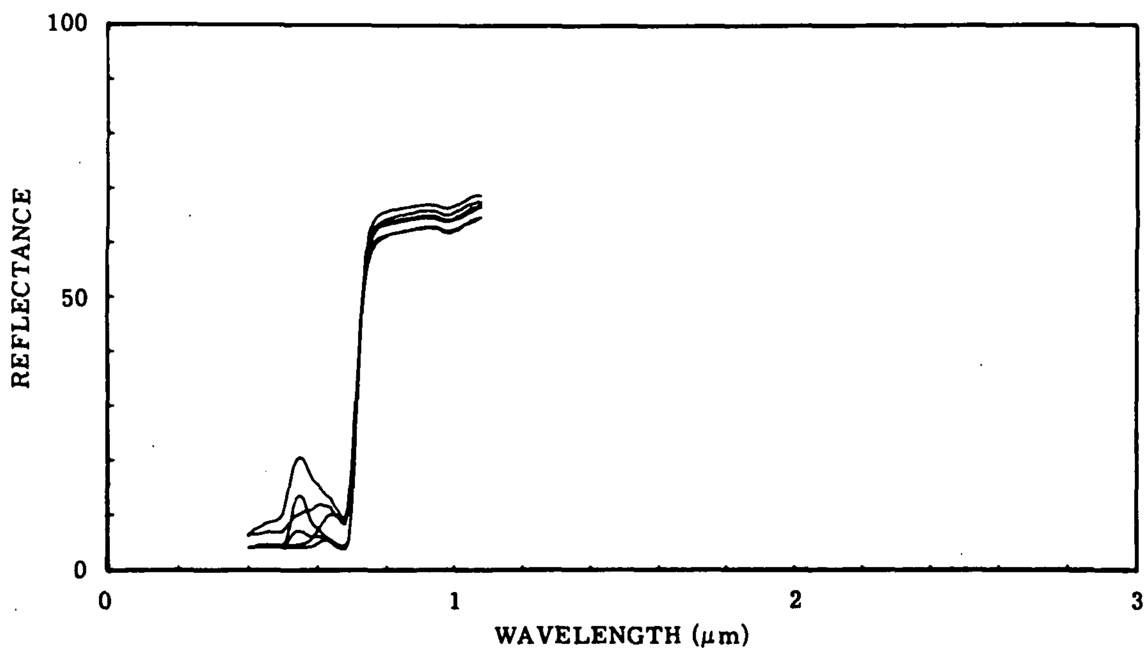


B01367-003	Dogwood leaf in container 17 hr, ventral side
B01367-004	Dogwood leaf in container 17 hr, dorsal side
B01368-006	Dogwood leaf, red and green, ventral side
B01368-007	Dogwood leaf, red and green, dorsal side
B01368-015	Dogwood leaf, ventral side
B01368-016	Dogwood leaf, ventral side
B01176-002	Dogwood leaf, green
B00829-041	Dogwood leaf, mature green, ventral side
B00829-110	Dogwood, new leaf
B00829-111	Dogwood leaf in sunshine 3 hr
B00829-112	Dogwood leaf in sunshine 5 hr
B00829-113	Dogwood leaf in sunshine 1 day
B00829-114	Dogwood leaf in sunshine 4 days
B00829-115	Dogwood leaf in shade 5 hr
B00829-116	Dogwood leaf in shade 1 day
B00829-117	Dogwood leaf in shade 1 day and 5 hr
B00829-118	Dogwood leaf in shade 4 days
B00829-119	Dogwood, new leaf
B00829-120	Dogwood leaf in shade 1 or 2 days

B00829-121	Dogwood leaf in shade 5 days
B00829-122	Dogwood leaf in shade 9 days
B00829-123	Dogwood, new leaf
B00829-124	Dogwood leaf in a room for 1 day
B00829-125	Dogwood leaf in a room for 2 or 5 days
B00829-126	Dogwood leaf in a room for 8 days
B00829-127	Dogwood leaf in a room for 69 days
B00829-152	Dogwood, new leaf
B00829-153	Dogwood leaf exposed on roof for 1 day
B00829-154	Dogwood leaf exposed on roof for 2 days
B00829-155	Dogwood leaf exposed on roof for 5 days
B00829-156	Dogwood leaf exposed on roof for 9 days
B14004-032	Dogwood leaf, dorsal side
B14004-033	Dogwood leaf, 2 days old
B14004-035	Dogwood leaf, ventral side
B14004-037	Dogwood leaf, 2 days old

46

HAZELNUT

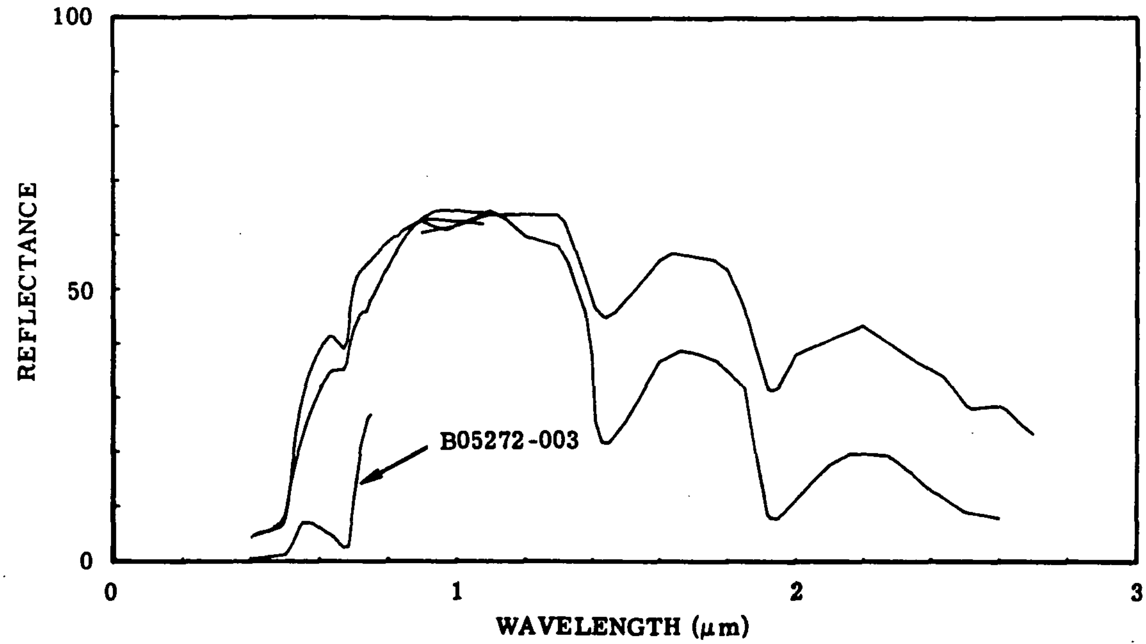


B01368-024	Leaf, Spanish hazelnut, red, ventral side
B01368-025	Leaf, Spanish hazelnut, red, dorsal side
B01368-026	Leaf, Spanish hazelnut, red and green, ventral side

B01368-027	Leaf, Spanish hazelnut, red and green, dorsal side
B01368-028	Leaf, Spanish hazelnut, green spot, ventral side
B01368-029	Leaf, Spanish hazelnut, green spot, dorsal side

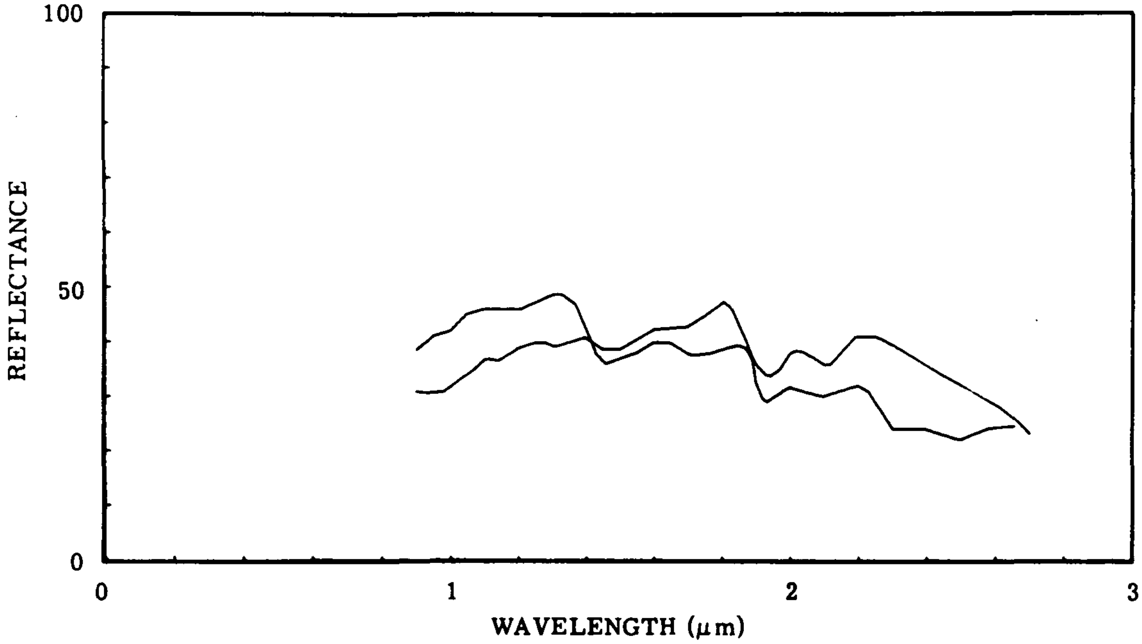
47

HICKORY



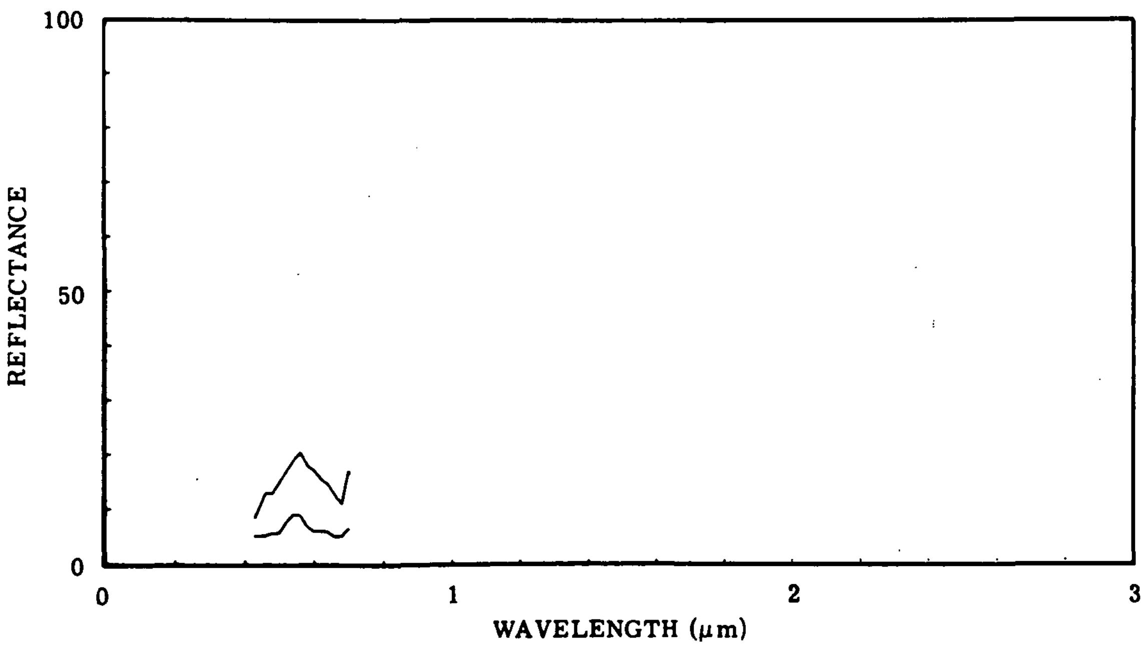
B00829-028	Shagbark hickory, leaf top, green, mature
B00829-030	Hickory leaf, top yellowed, not fallen
B05272-003	Hickory leaves

48
BARK
Nut Tree



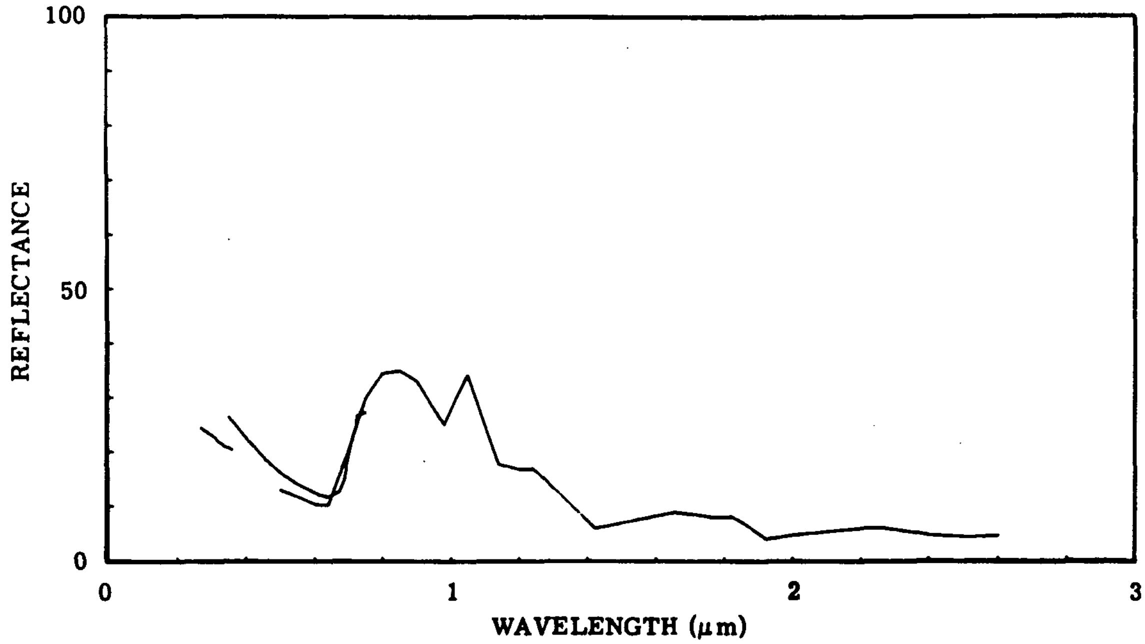
B00829-072	Hickory bark from young tree, southwest exposure
B00829-089	Black walnut, native, bark

49
CHESTNUT



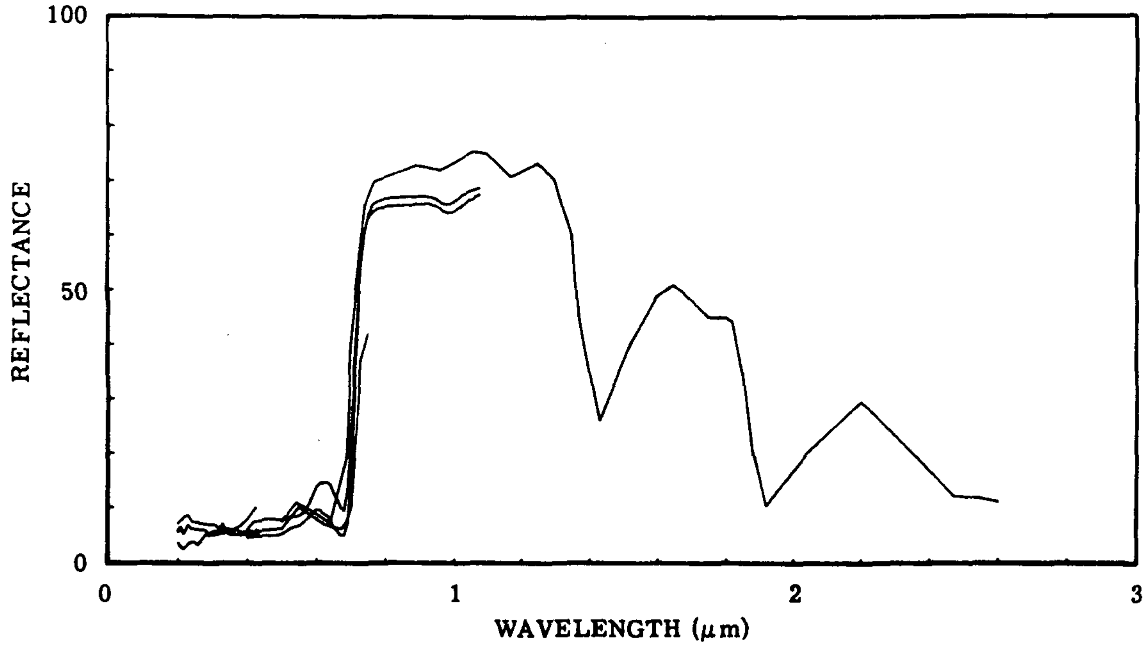
B01761-021 Chestnut (Castanea dentata), upper leaf surface
B01761-022 Chestnut (Castanea dentata), lower leaf surface

50
PLUM
Fruit



B02418-405 UV, fruit-plum, purple color
B02418-406 Visible, fruit-plum, purple color
B02418-407 IR, fruit-plum, purple color

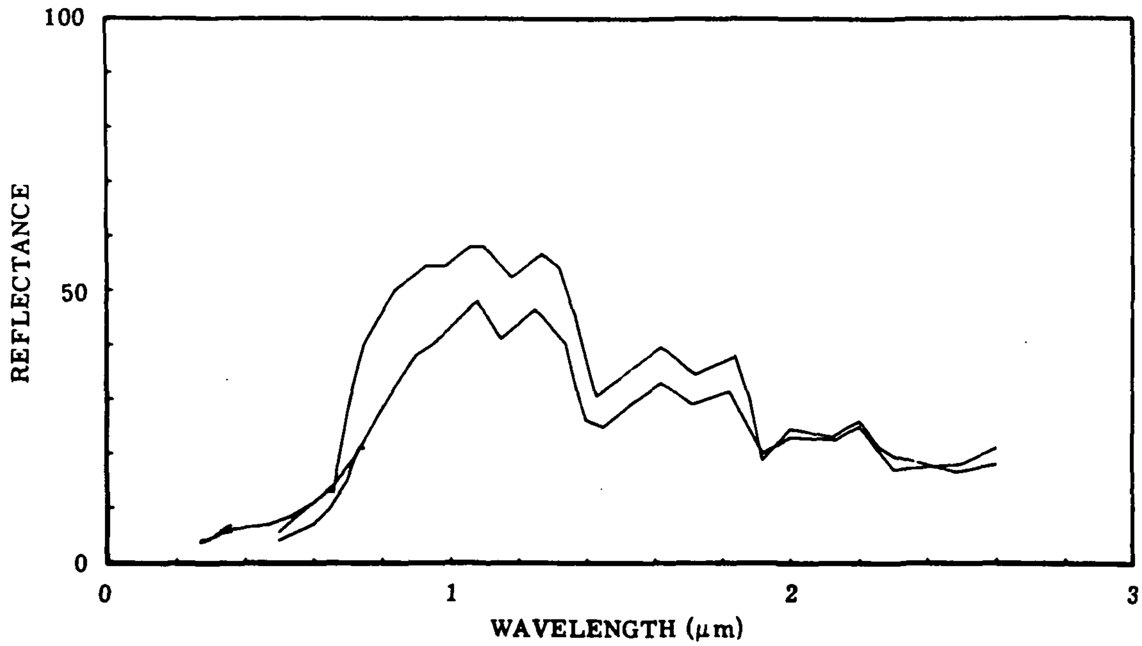
51
PLUM TREE
Leaves



B02418-368	Visibile, plum leaf, green
B02418-369	IR, plum leaf, green
B02418-380	UV, plum twig
B01368-030	Leaf, plum, red, ventral side
B01368-031	Leaf, plum, red, dorsal side
B14004-038	Japanese plum leaf, bottom
B14004-039	Japanese plum leaf, top
B14004-040	Japanese plum leaf

52

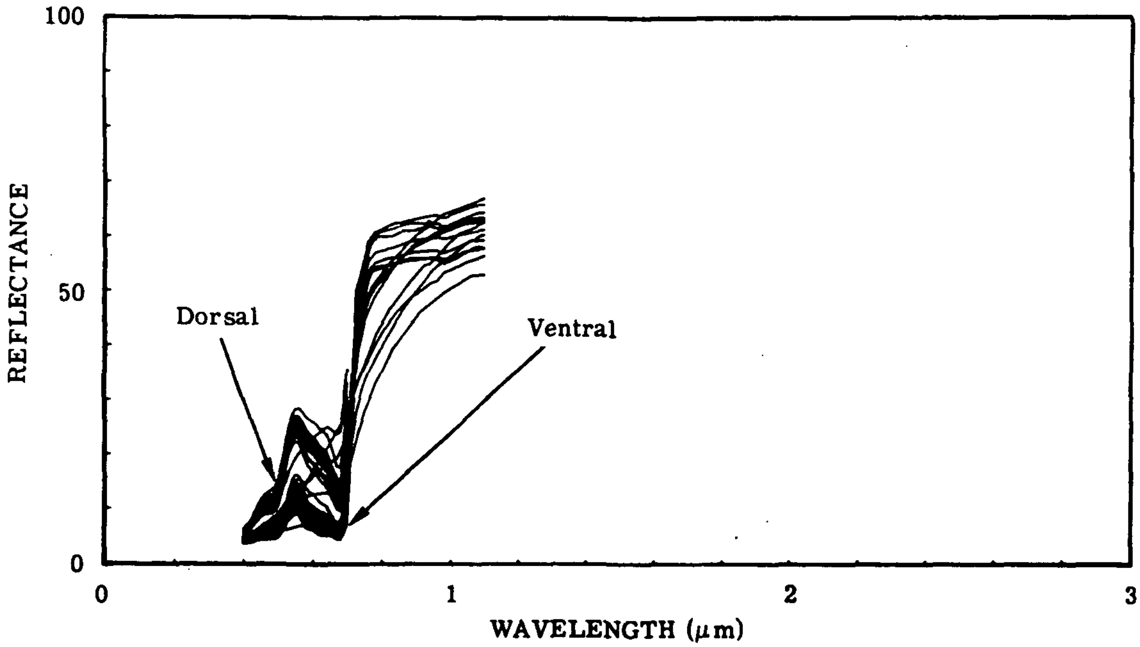
PLUM TREE BARK



B02418-382	IR, plum twig
B02418-399	UV, plum tree bark, reddish gray
B02418-400	Visible, plum tree bark, reddish gray
B02418-401	IR, plum tree bark, reddish gray

53

ASH TREE



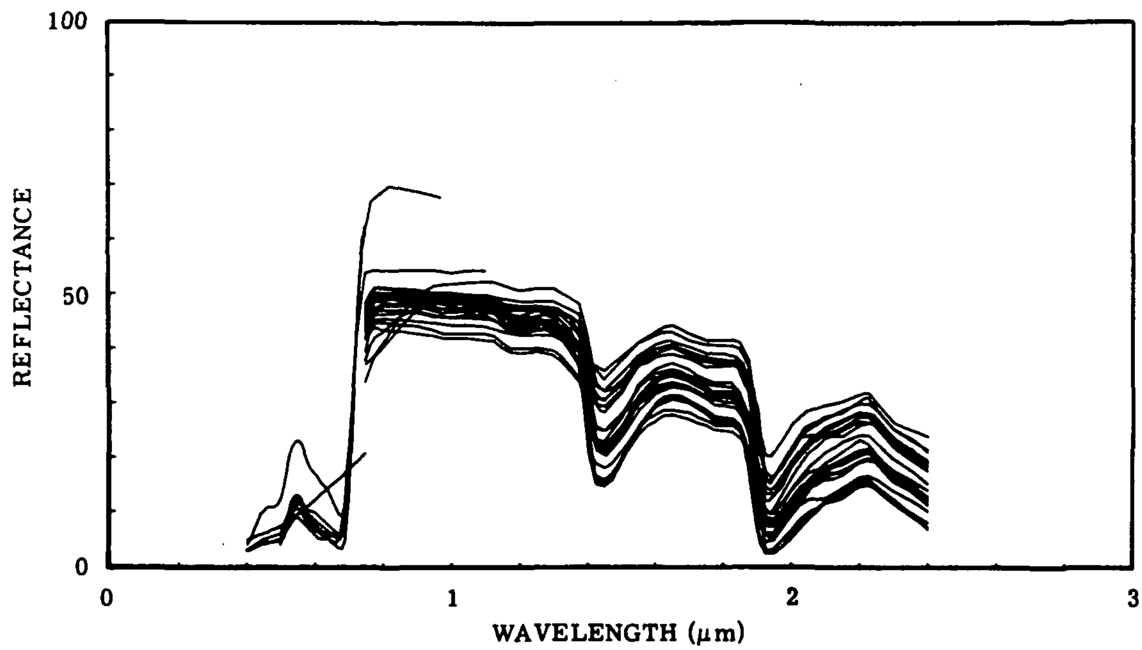
B00829-128	American ash, new leaf
B00829-129	American ash, leaf in shade for 1 day
B00829-130	American ash, leaf in shade for 2 days
B00829-131	American ash, leaf in shade for 5 days
B00829-132	American ash, leaf in shade for 8 days
B00829-133	American ash, new leaf
B00829-134	American ash, leaf on roof for 1 day
B00829-135	American ash, leaf on roof for 2 days
B00829-136	American ash, leaf on roof for 5 days
B00829-137	American ash, leaf on roof for 9 days
B00829-163	American ash, new leaf
B00829-164	American ash, leaf in a room for 1 day
B00829-165	American ash, leaf in a room for 2 days
B00829-166	American ash, leaf in a room for 5 days
B00829-167	American ash, leaf in a room for 8 days
B00829-168	American ash, leaf in a room for 69 days, upper one-third of upper leaf surface, 27 May 1960
B03374-308	White ash, (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 3 June 1960

B03374-309	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 10 June 1960
B03374-310	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 17 June 1960
B03374-311	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 24 June 1960
B03374-312	White ash, (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 8 July 1960
B03374-313	White ash, (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 15 July 1960
B03374-314	White ash,(Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 22 July 1960
B03374-315	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 29 July 1960
B03374-316	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 5 August 1960
B03374-317	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 22 August 1960
B03374-318	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 26 August 1960
B03374-319	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 2 September 1960
B03374-320	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 9 September 1960
B03374-321	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 16 September 1960
B03374-322	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface 21 September 1960
B03374-323	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface 28 September 1960
B03374-324	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 5 October 1960
B03374-325	White ash, (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 12 October 1960
B03374-326	White ash (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 20 October 1960
B03374-327	White ash, (Fraxinus americana L.), crown position, south side, upper one-third of upper leaf surface, 26 October 1960
B03374-328	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 27 May 1960
B03374-329	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 3 June 1960
B03374-330	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 10 June 1960

B03374-331	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 17 June 1960
B03374-332	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 24 June 1960
B03374-333	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 8 July 1960
B03374-334	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 15 July 1960
B03374-335	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 22 July 1960
B03374-336	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 29 July 1960
B03374-337	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 5 August 1960
B03374-338	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 22 August 1960
B03374-339	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 26 August 1960
B03374-340	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 2 September 1960
B03374-341	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 9 September 1960
B03374-342	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 16 September 1960
B03374-343	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 21 September 1960
B03374-344	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 28 September 1960
B03374-345	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 5 October 1960
B03374-346	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 12 October 1960
B03374-347	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 20 October 1960
B03374-348	White ash (Fraxinus americana L.), crown position, south side, upper one-third of lower leaf surface, 26 October 1960

54

ASPEN



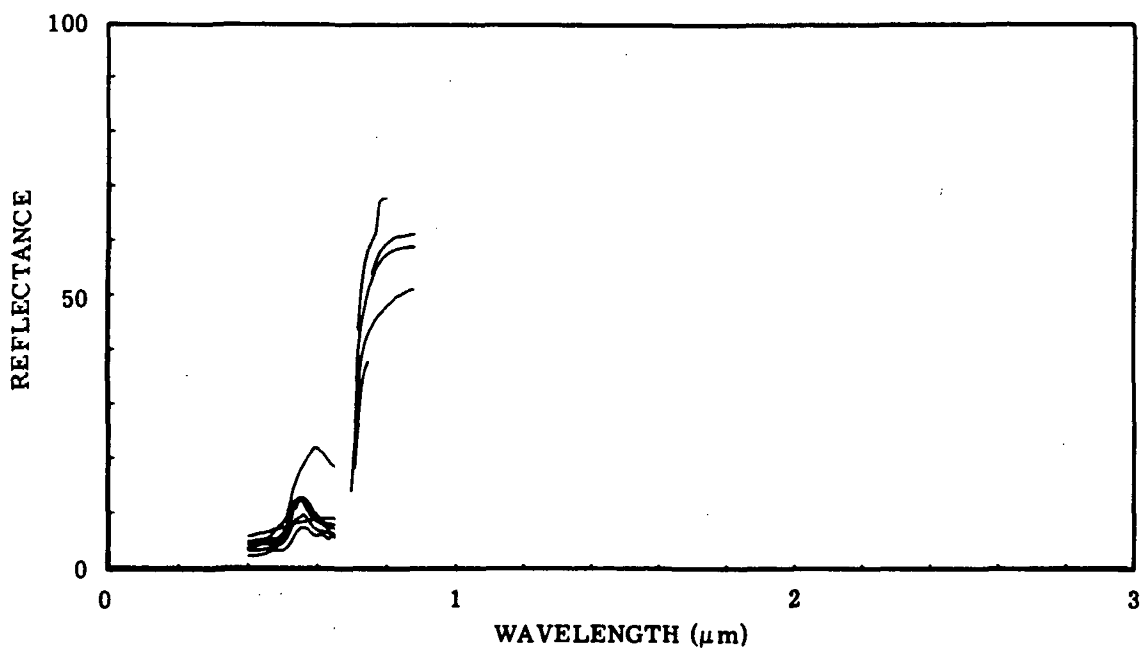
B01368-001	Leaf, aspen, blackening, ventral
B01368-032	Leaf, Trembling aspen, ventral
B01368-033	Leaf, Trembling aspen, dorsal
B01049-014	Populus tremuloides
B03355-017	Aspen leaves (Summer, 1951)
B03355-023	Aspen tree (16-31 May 1952)
B03355-028	Aspen tree (1-15 June 1952)
B03355-034	Aspen tree (16-30 June 1952)
B20000-088	Aspen, lower leaf surface, before picking
B20000-089	Aspen, upper leaf surface, before picking
B20000-090	Aspen, lower leaf surface, before picking
B20000-091	Aspen, upper leaf surface, before picking
B20000-092	Aspen, upper leaf surface, before picking
B20000-093	Aspen, lower leaf surface, before picking
B20000-094	Aspen, upper leaf surface, before picking
B20000-095	Aspen, lower leaf surface, before picking
B20000-096	Aspen, upper leaf surface, before picking
B20000-097	Aspen, lower leaf surface, before picking
B20000-098	Aspen, upper leaf surface, before picking

B20000-099	Aspen, lower leaf surface, before picking
B20000-102	Aspen, upper leaf surface, 1 hr after picking
B20000-103	Aspen, lower leaf surface, 1 hr after picking
B20000-104	Aspen, upper leaf surface, 2 hr after picking
B20000-105	Aspen, lower leaf surface, 2 hr after picking
B20000-106	Aspen, upper leaf surface, before picking
B20000-107	Aspen, lower leaf surface, before picking
B20000-108	Aspen, upper leaf surface, before picking
B20000-109	Aspen, lower leaf surface, before picking
B20000-110	Aspen, upper leaf surface, before picking
B20000-111	Aspen, lower leaf surface, before picking

55

ASPEN

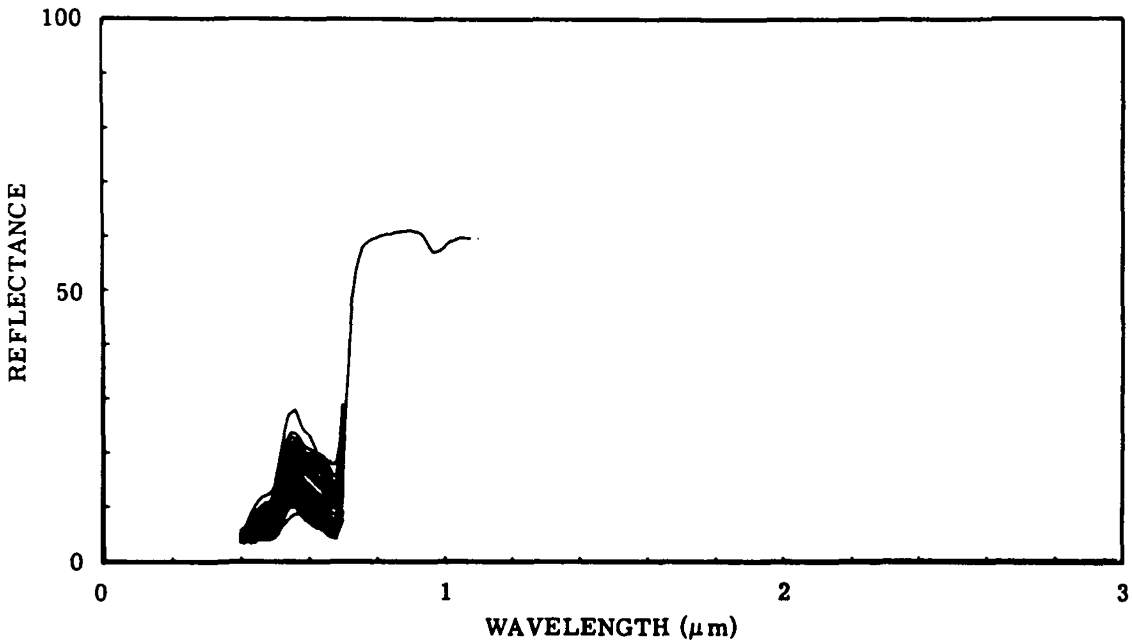
Krinov Field Data



B03995-036	Aspen, young forest, winter stage
B03995-037	Aspen, young forest, young leaf stage
B03995-038	Aspen, young forest, full leaf stage
B03995-039	Aspen, mature forest, young leaf stage
B03995-040	Aspen, mature forest, full leaf stage
B03995-041	Aspen, mature forest, late summer green
B03995-042	Aspen, mature forest, autumn color

56

BASSWOOD

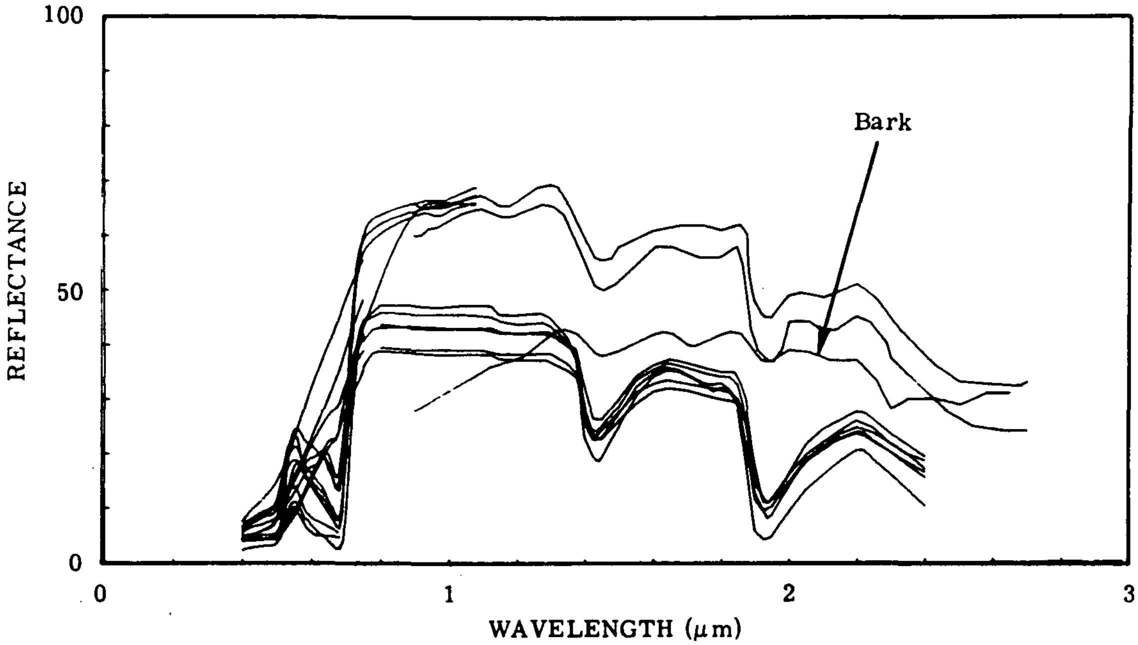


B01368-056	Leaf, basswood, ventral side
B03374-257	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface 3 May 1960
B03374-258	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 11 May 1960
B03374-259	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 13 May 1960
B03374-260	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 23 May 1960
B03374-261	American basswood (Tilia americana L.), crownposition, south side, upper one-third of upper leaf surface, 31 May 1960
B03374-262	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 3 June 1960
B03374-263	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 15 June 1960
B03374-264	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 17 June 1960
B03374-265	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 24 June 1960
B03374-266	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 8 July 1960
B03374-267	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 15 July 1960

B03374-268	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 22 July 1960
B03374-269	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 29 July 1960
B03374-270	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 5 August 1960
B03374-271	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 22 August 1960
B03374-272	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 26 August 1960
B03374-273	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 2 September 1960
B03374-272	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 9 September 1960
B03374-275	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 16 September 1960
B03374-276	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 21 September 1960
B03374-277	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 28 September 1960
B03374-278	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 5 October 1960
B03374-279	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 12 October 1960
B03374-280	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 20 October 1960
B03374-281	American basswood (Tilia americana L.), crown position, south side, upper one-third of upper leaf surface, 26 October 1960
B03374-282	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 3 May 1960
B03374-282	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 11 May 1960
B03374-284	American vasswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 13 May 1960
B03374-285	American basswood (Tilia-americana L.), crown position, south side, upper one-third of lower leaf surface, 23 May 1960
B03374-286	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 31 May 1960
B03374-287	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 3 June 1960
B03374-288	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 15 June 1960
B03374-289	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 17 June 1960

B03374-290	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 24 June 1960
B03374-291	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 8 July 1960
B03374-292	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 15 July 1960
B03374-293	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 22 July 1960
B03374-294	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 29 July 1960
B03374-295	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 5 August 1960
B03374-296	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 22 August 1960
B03374-297	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 26 August 1960
B03374-298	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 2 September 1960
B03374-299	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 9 September 1960
B03374-300	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 16 September 1960
B03374-301	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 21 September 1960
B03374-302	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 28 September 1960
B03374-303	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 5 October 1960
B03374-304	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 12 October 1960
B03374-305	American basswood (Tilia americana L.), crown position, south side, upper one-third of lower leaf surface, 20 October 1960
B03374-306	American basswood (Tilia americama L.), crown position, south side, upper one-third of lower leaf surface, 26 October 1960
B01761-037	Basswood (Tilia americana), young, upper leaf surface
B01761-038	Basswood (Tilia americana), medium, upper leaf surface
B01761-039	Basswood (Tilia americana), old, upper leaf surface

57
BEECH

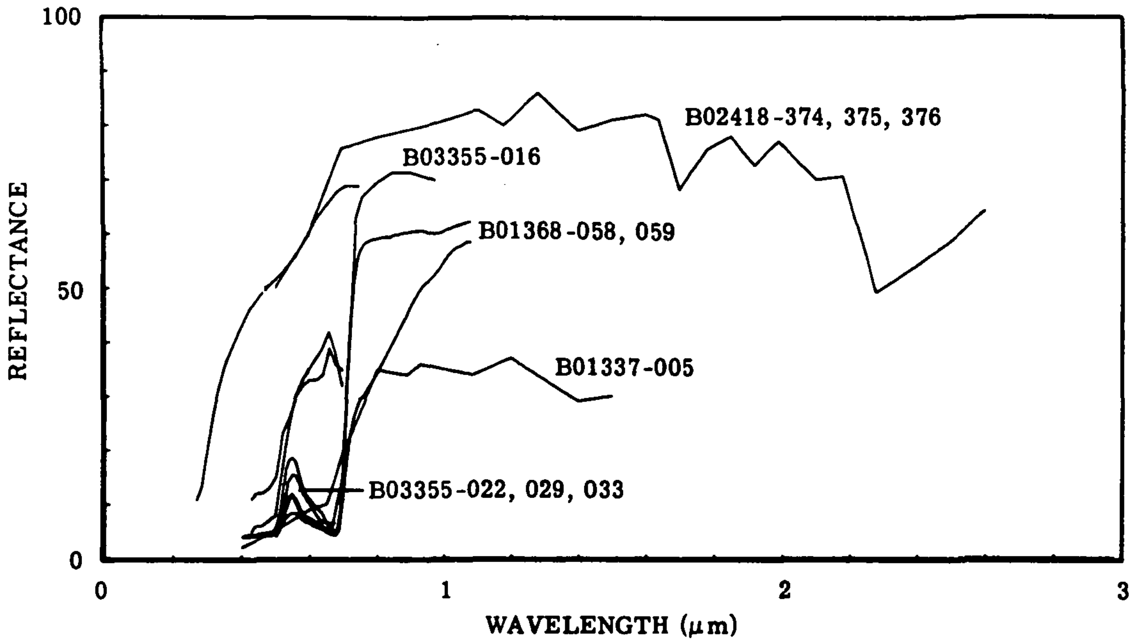


B01367-001	Leaf, in container 17 hr, beech, ventral side
B01367-002	Leaf, in container 17 hr, beech, dorsal side
B01368-003	Leaf, beech, russet brown, ventral
B01368-003	Leaf, beech, russet brown, dorsal
B01368-004	Leaf, beech, yellow, ventral
B01368-005	Leaf, beech, yellow, dorsal
B01368-014	Leaf, beech, ventral side
B01368-034	Leaf, beech, brown, ventral
B01368-035	Leaf, beech, brown, dorsal
B01368-036	Leaf, beech, green, ventral
B01368-037	Leaf, beech, green, dorsal
B01368-057	Leaf, beech, ventral side
B00829-056	Beech leaf, top, yellowing, not fallen
B00829-057	Beech leaf, top, brown, drying
B00829-073	American beech, bark southwest exposure
B03355-020	Beech tree (16-31 May 1952)
B03355-027	Beech tree (1 15 June 1952)
B03355-035	Beech tree (16-30 June 1952)
B20000-112	Beech, tree in forest, upper leaf surface, before picking

B20000-113	Beech, tree in forest, lower leaf surface, before picking
B20000-120	Beech, upper leaf surface, before picking
B20000-121	Beech, lower leaf surface, before picking
B20000-122	Beech, upper leaf surface, 10 min after picking
B20000-123	Beech, lower leaf surface, 10 min after picking

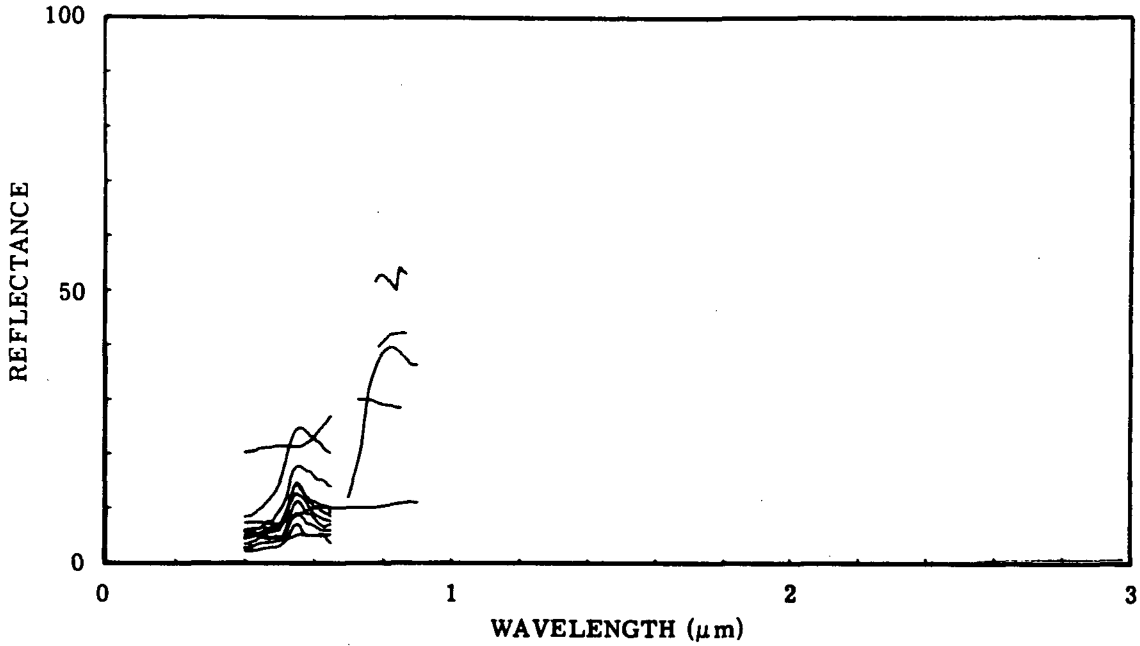
58

BIRCH



B02418-374	UV, paper birch twing, white
B02418-375	Visible, paper birch twig, white
B02418-376	IR, paper birch twig, white
B01368-058	Leaf, white birch, ventral side
B01368-059	Leaf, yellow birch, ventral side
B01337-005	Dwarf birch
B03355-016	Birch leaves (summer, 1951)
B03355-022	Birch tree (16-31 May 1952)
B03355-029	Birch tree (1-15 June 1952)
B03355-033	Birch tree (16-30 June 1952)
B01761-068	White birch (Betula alba), upper leaf surface
B01761-069	White birch (Betula alba), lower leaf surface

59
BIRCH
Krinov Field Data

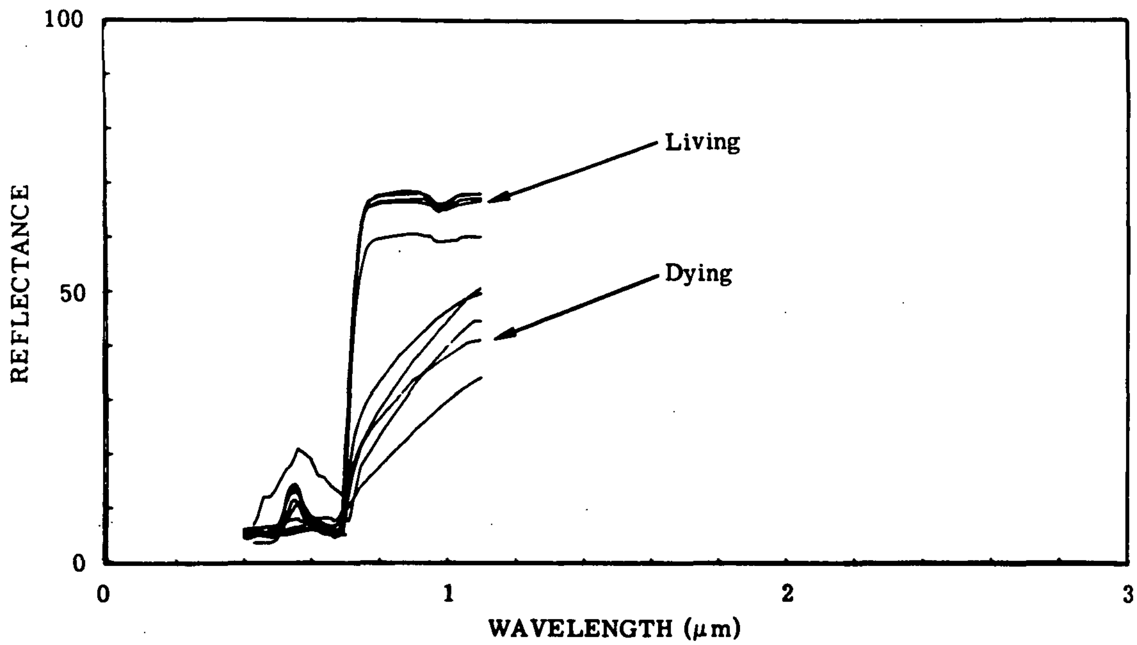


B03995-001	Birch, shoots, full leaf
B03995-002	Birch, young forest, winter stage
B03995-003	Birch, young forest, young leaf stage
B03995-004	Birch, young forest, old leaf stage
B03995-005	Birch, young forest, late summer green
B03995-006	Birch, mature forest, winter stage
B03995-007	Birch, mature forest, young leaf stage
B03995-008	Birch, mature forest, full leaf stage
B03995-009	Birch, mature forest, late summer green
B03995-010	Birch, dwarf, full leaf stage
B03995-011	Birch bark, on a mature tree

60

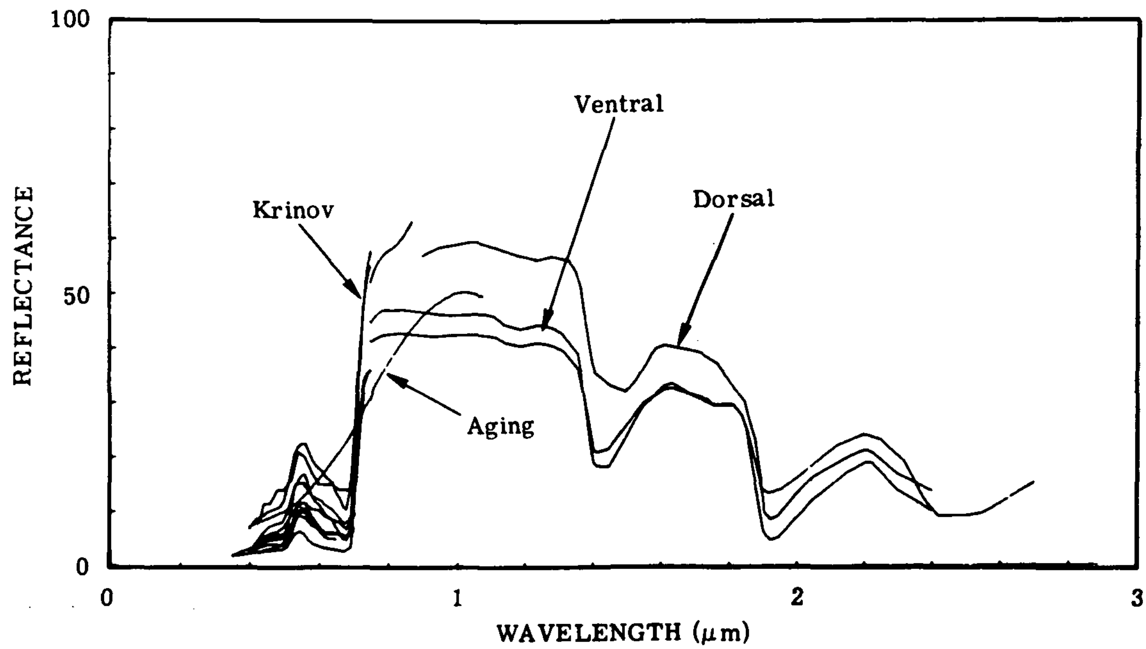
CATALPA

Time Study



B00829-148	Catalpa, new leaf
B00829-149	Catalpa, leaf in a room for 3 days
B00829-150	Catalpa, leaf in a room for 6 days
B00829-151	Catalpa, leaf in a room for 67 days
B00829-157	Catalpa, new leaf
B00829-158	Catalpa, leaf in shade for 3 days
B00829-159	Catalpa, leaf in shade for 6 days
B00829-160	Catalpa, new leaf
B00829-161	Catalpa, leaf on roof for 3 days
B00829-162	Catalpa, leaf on roof for 7 days
B01761-019	Catalpa (Catalpa bignonioides), upper leaf surface
B01761-020	Catalpa (Catalpa bignonioides), lower leaf surface

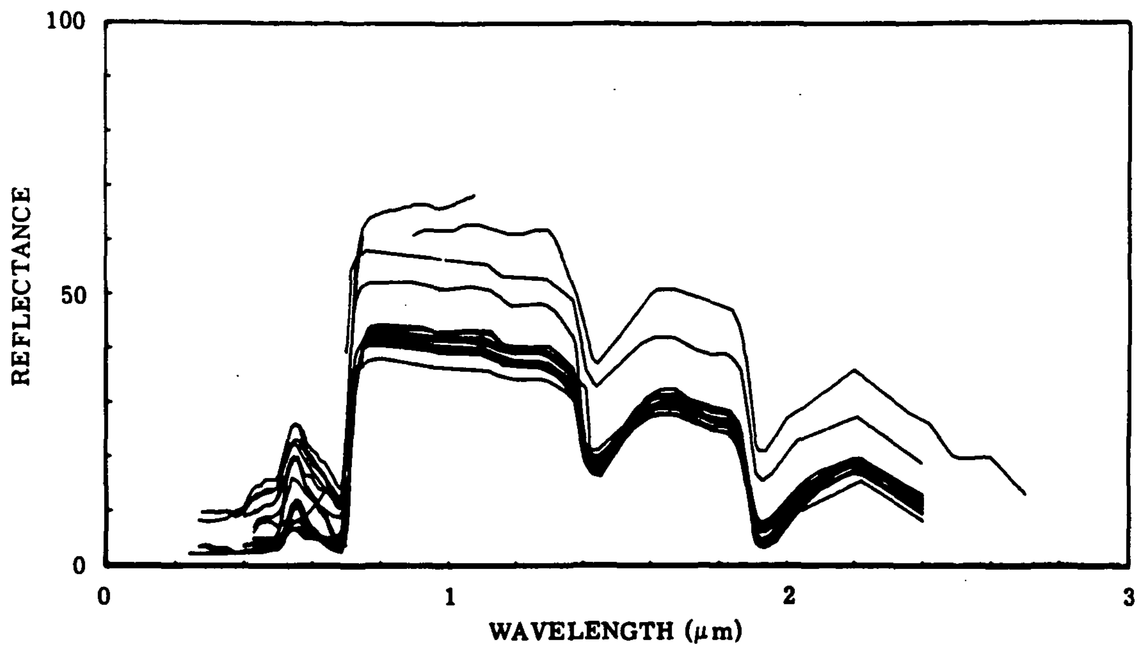
61
ELM



B01368-038	Leaf, white elm, ventral
B01368-039	Leaf, white elm, dorsal
B01368-061	Leaf, white elm, ventral side
B00829-055	Elm leaf, aging, top, brown, not fallen
B03995-012	Elm, mature forest, young leaf stage
B03995-013	Elm, mature forest, full leaf
B03995-027	Elm, black, mature forest, late summer, coated with dust
B20000-303	Elm leaf, upper surface, freshly picked
B20000-304	Elm leaf, lower surface, freshly picked
B20000-305	Elm leaf, upper surface, freshly picked
B20000-306	Elm leaf, lower furface, freshly picked
B01761-001	American elm (Ulmus americana), upper leaf surface
B01761-002	American elm (Ulmus americana), lower leaf surface
B01761-003	American elm (Ulmus americana), upper leaf surface
B01761-004	American elm (Ulmus americana), lower leaf surface

62

MAPLE, GREEN

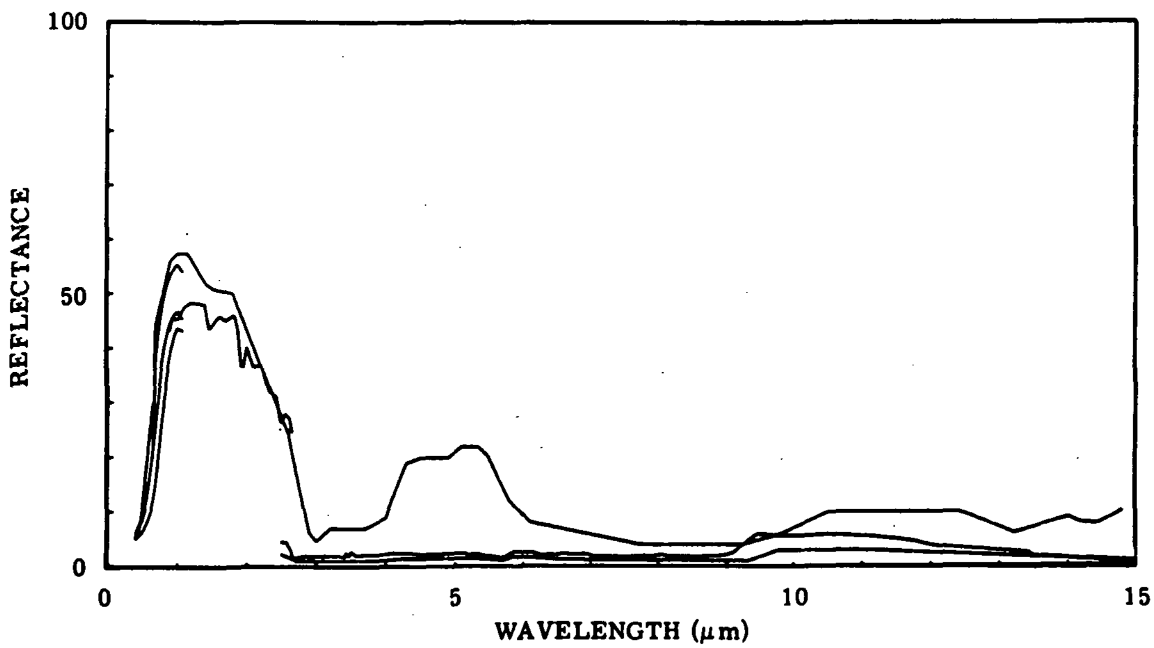


B01368-046	Leaf, sugar maple, ventral
B01368-047	Leaf, sugar maple, dorsal
B01368-063	Leaf, sugar maple, ventral side
B00829-045	Maple, leaf, top
B20000-193	Maple, upper leaf surface, before picking
B20000-194	Maple, lower leaf surface, before picking
B20000-195	Maple, upper leaf surface, before picking
B20000-196	Maple, lower leaf surface, before picking
B20000-197	Maple, upper leaf surface, before picking
B20000-198	Maple, lower leaf surface, before picking
B20000-199	Maple, upper leaf surface, before picking
B20000-200	Maple, lower leaf surface, before picking
B20000-201	Maple, upper leaf surface, before picking
B20000-202	Maple, lower leaf surface, before picking
B20000-203	Maple, upper leaf surface, 2 hr after picking
B20000-204	Maple, lower leaf surface, 2 hr after picking
B20000-205	Maple, upper leaf surface, before picking
B20000-206	Maple, lower leaf surface, before picking
B20000-207	Maple, upper leaf surface, before picking

B20000-208	Maple, lower leaf surface, before picking
B20000-209	Maple, upper leaf surface, before picking
B20000-210	Maple, lower leaf surface, before picking
B20000-211	Maple, upper leaf surface, before picking
B20000-212	Maple, lower leaf surface, before picking
B20000-218	Maple, upper leaf surface, before picking
B20000-378	Maple (Acer sacharum), upper leaf surface, brilliant red resulting from seasonal color change, freshly picked
B20000-379	Maple (Acer sacharum), upper leaf surface, brilliant red resulting from seasonal color change, freshly picked
B01761-005	Maple (Acer platanoides), upper leaf surface
B01761-006	Maple (Acer platanoides), lower leaf surface
B01761-007	Maple (Acer platanoides), upper leaf surface
B01761-008	Maple (Acer platanoides), lower leaf surface
B01761-063	Maple (Acer palmatum atropurpureum), upper leaf surface
B01761-064	Maple (Acer palmatum atropurpureum), lower leaf surface

63

MAPLE, DEAD

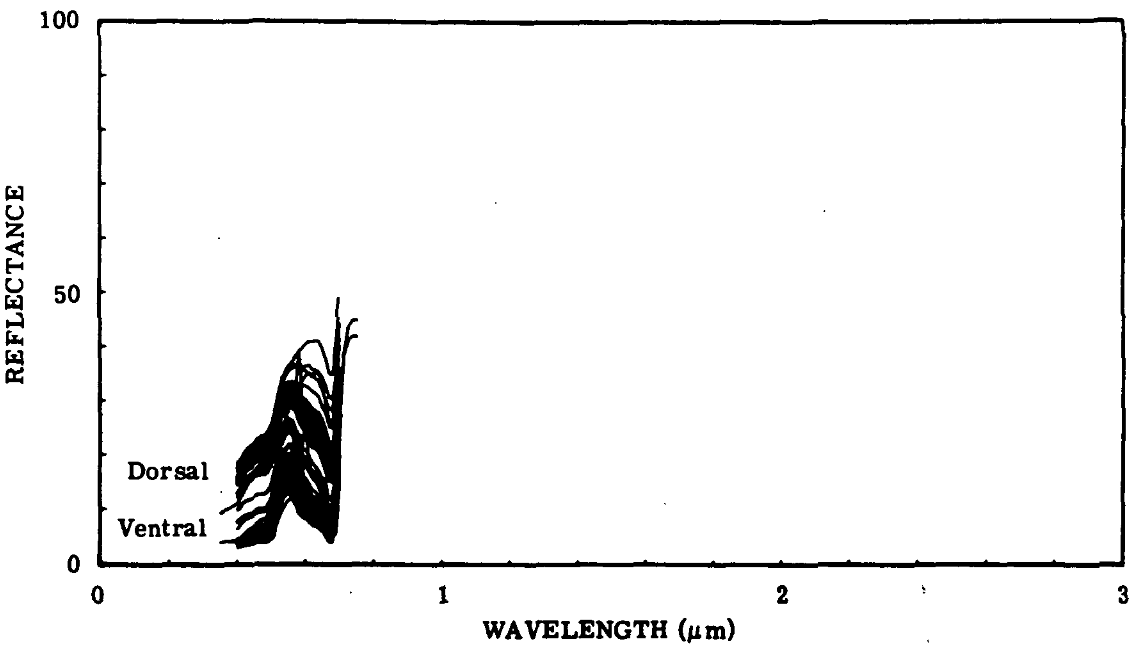


B00829-060	Cutleaf maple, top, dry, red, fallen
B01368-064	Leaf, Sugar maple, light brown, ventral side
B01368-065	Leaf, Sugar maple, medium brown, ventral side
B01368-066	Leaf, Sugar maple, dark brown, ventral side

B01818-012	Maple leaf, pressed dormant, top (Acer rubrum) dry
B01370-001	Maple tree (Orlando, Florida)
B03333-016	Sugar maple

64

SILVER MAPLE



B03374-101	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 2 May 1960
B03374-102	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 6 May 1960
B03374-103	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 13 May 1960
B03374-104	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 23 May 1960
B03374-105	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 27 May 1960
B03374-106	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 6 June 1960
B03374-107	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 10 June 1960
B00374-108	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 20 June 1960
B03374-109	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 24 June 1960

B03374-110	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 8 July 1960
B03374-111	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 15 July 1960
B03374-112	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 22 July 1960
B03374-113	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 29 July 1960
B03374-114	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 5 August 1960
B03374-115	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 19 August 1960
B03374-116	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 26 August 1960
B03374-117	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 2 September 1960
B03374-118	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 12 September 1960
B03374-119	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 16 September 1960
B03374-120	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-thire of upper leaf surface, 21 September 1960
B03374-121	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 28 September 1960
B03374-122	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 5 October 1960
B03374-123	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 12 October 1960
B03374-124	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 20 October 1960
B03374-125	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 26 October 1960
B03374-126	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 2 November 1960
B03374-127	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 2 May 1960
B03374-128	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 6 May 1960
B03374-129	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 13 May 1960
B03374-130	Silver maple, (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface,23 May 1960
B03374-131	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 27 May 1960

B03374-132	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 6 June 1960
B03374-133	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 10 June 1960
B03374-134	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 20 June 1960
B03374-135	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 24 June 1960
B03374-136	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 8 July 1960
B03374-137	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 15 July 1960
B03374-138	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 22 July 1960
B03374-139	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 29 July 1960
B03374-140	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 5 August 1960
B03374-141	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 19 August 1960
B03374-142	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 26 August 1960
B03374-143	Silver maple (Acer saccharinum L), crown position, south side, upper one-third of lower leaf surface, 2 September 1960
B03374-144	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 12 September 1960
B03374-145	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 16 September 1960
B03374-146	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 21 September 1960
B03374-147	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 28 September 1960
B03374-148	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 5 October 1960
B03374-149	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 12 October 1960
B03374-150	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 20 October 1960
B03374-151	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 26 October 1960
B03374-152	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 2 November 1960
B03374-519	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 16 May 1961

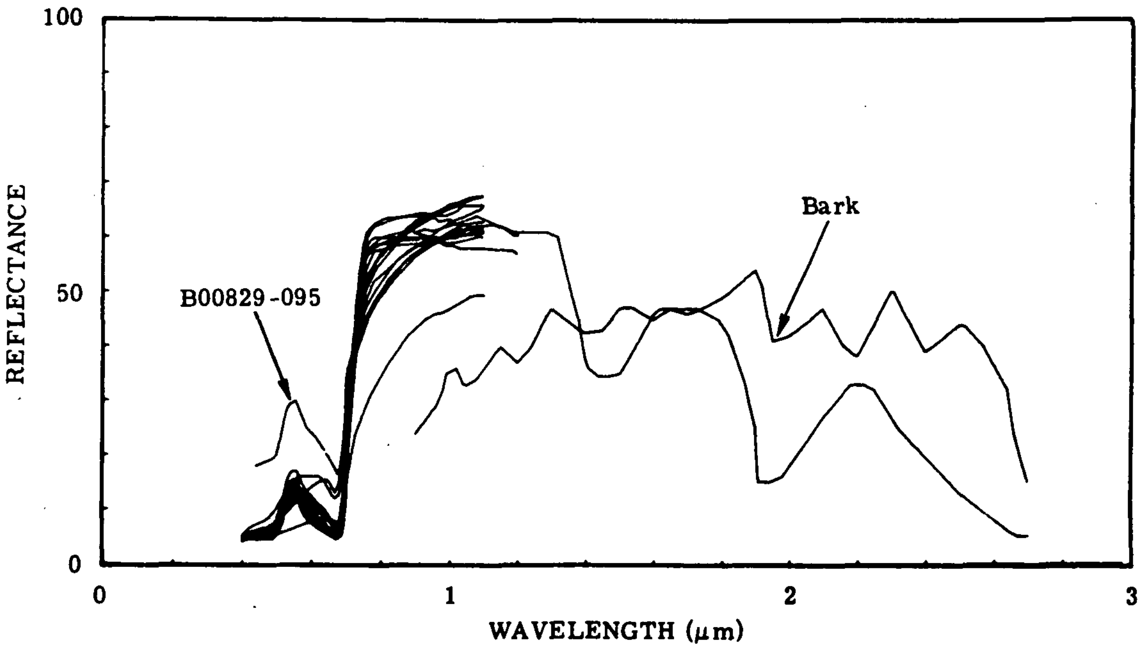
B03374-520	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 25 May 1961
B03374-521	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 2 June 1961
B03374-522	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 6 June 1961
B03374-523	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 13 June 1961
B03374-524	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 21 June 1961
B03374-525	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 27 June 1961
B03374-526	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 5 July 1961
B03374-527	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 11 July 1961
B03374-528	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 18 July 1961
B03374-529	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 26 July 1961
B03374-530	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 1 August 1961
B03374-531	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 8 August 1961
B03374-532	Silver maple (Acer saccharinum L), crown position, south side, upper one-third of upper leaf surface, 15 August 1961
B03374-533	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 22 Aubust 1961
B03374-534	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 29 August 1961
B03374-535	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 6 September 1961
B03374-536	Silver maple (Acer saccharinum L.) crown position, south side, upper one-third of upper leaf surface, 11 September 1961
B03374-537	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 18 September 1961
B03374-538	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 26 September 1961
B03374-539	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 2 October 1961
B03374-540	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 9 October 1961
B03374-541	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 17 October 1961

B03374-542	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of upper leaf surface, 25 October 1961
B03374-543	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 16 May 1961
B03374-544	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 25 May 1961
B03374-545	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 2 June 1961
B03374-546	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 6 June 1961
B03374-547	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 13 June 1961
B03374-548	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 21 June 1961
B03374-549	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 27 June 1961
B03374-550	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 5 July 1961
B03374-551	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 11 July 1961
B03374-552	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 18 July 1961
B03374-553	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 26 July 1961
B03374-554	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 1 August 1961
B03374-555	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 8 August 1961
B03374-556	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 15 August 1961
B03374-557	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 22 August 1961
B03374-558	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 29 August 1961
B03374-559	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 6 September 1961
B03374-560	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 11 September 1961
B03374-561	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 18 September 1961
B03374-562	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 26 September 1961
B03374-563	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 2 October 1961

B03374-564	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 9 October 1961
B03374-565	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 17 October 1961
B03374-566	Silver maple (Acer saccharinum L.), crown position, south side, upper one-third of lower leaf surface, 25 October 1961
B20000-356	Silver maple, upper leaf surface, 20 hr after picking
B20000-357	Silver maple, lower leaf surface, 20 hr after picking

65

RED MAPLE

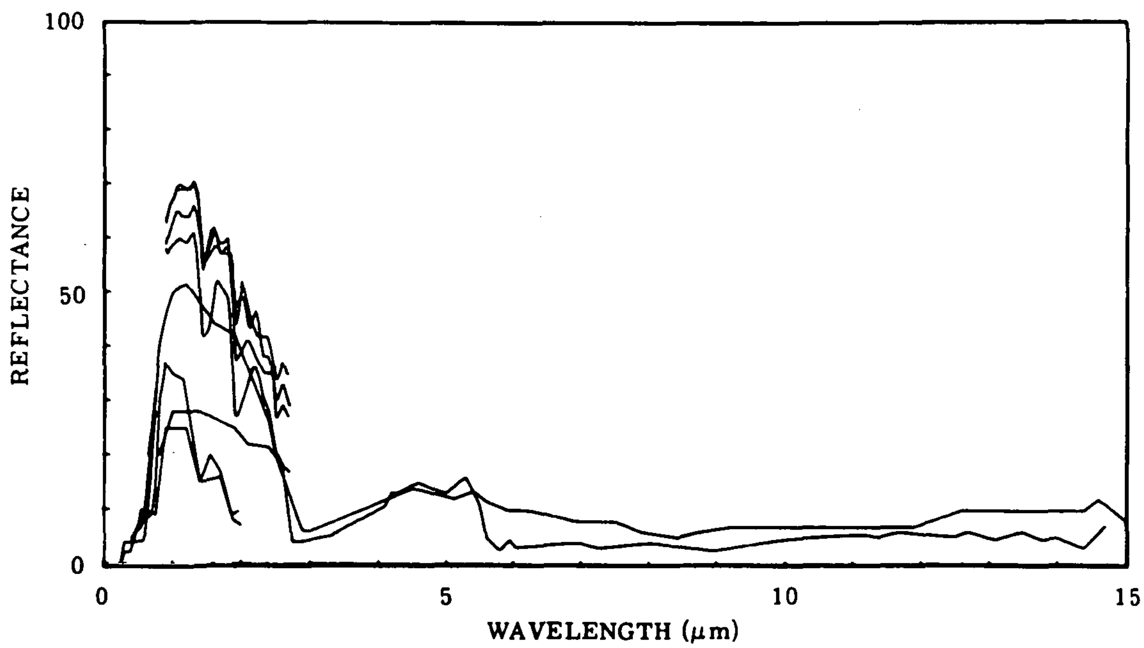


B01368-044	Leaf, Red maple, ventral
B01368-045	Leaf, Red maple, dorsal
B00829-004	Red maple leaf, top
B00829-007	Red maple, new leaf
B00829-008	Red maple, leaf in a room for 2 days
B00829-009	Red maple, leaf in a room for 5 days
B00829-010	Red maple, leaf in a room for 8 days
B00829-011	Red maple, leaf in a room for 69 days
B00829-094	Red maple, outside, picked August 4
B00829-095	Red maple, underside, picked August 4
B00829-096	Red maple bark

B00829-138	Red maple, new leaf
B00829-139	Red maple, leaf on roof for 1 day
B00829-140	Red maple, leaf on roof for 2 days
B00829 141	Red maple, leaf on roof for 5 days
B00829-142	Red maple, leaf on roof for 9 days
B00829-143	Red maple, new leaf
B00829-144	Red maple, leaf in shade for 1 day
B00829-145	Red maple, leaf in shade for 2 days
B00829-146	Red maple, leaf in shade for 5 days
B00829-147	Red maple, leaf in shade for 8 days

66

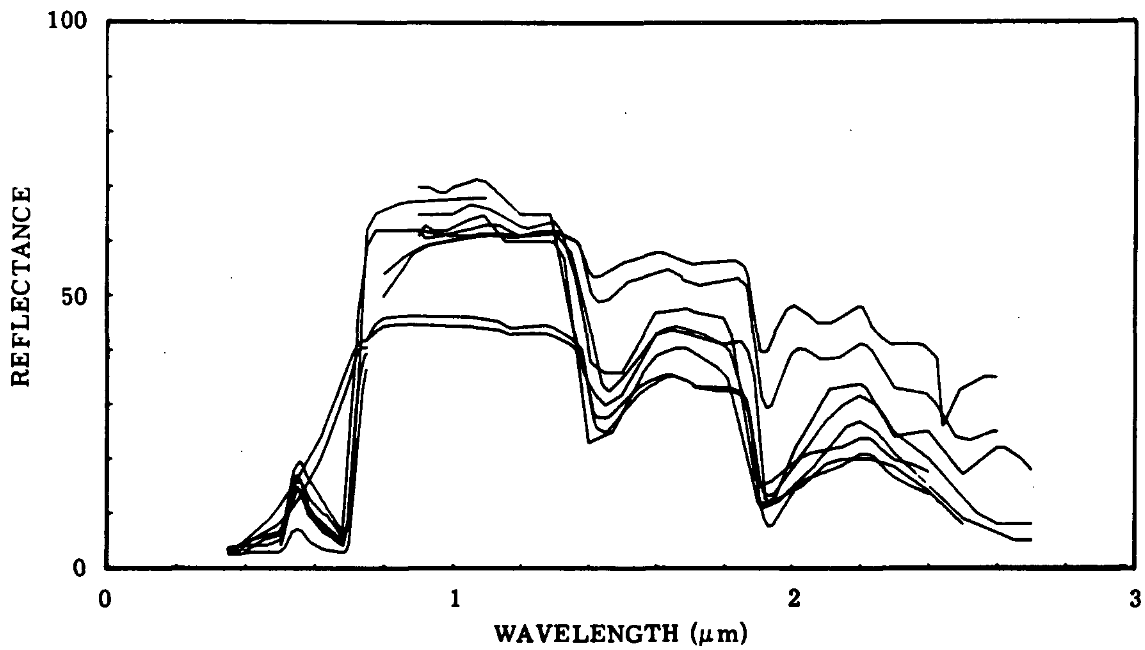
OAK, DEAD



B01368-008	Leaf, scarlet oak, red, ventral
B01368-009	Leaf, scarlet oak, red, dorsal
B01337-014	Scrub oak
B01337-026	Scrub oak
B00829-023	Southern Red oak leaf, back
B00829-048	Southern Red oak leaf, top, dry, brown, fallen
B00829-049	Southern Red oak leaf, back, dry, brown, fallen
B00829-051	Chestnut oak leaf, dry, fallen

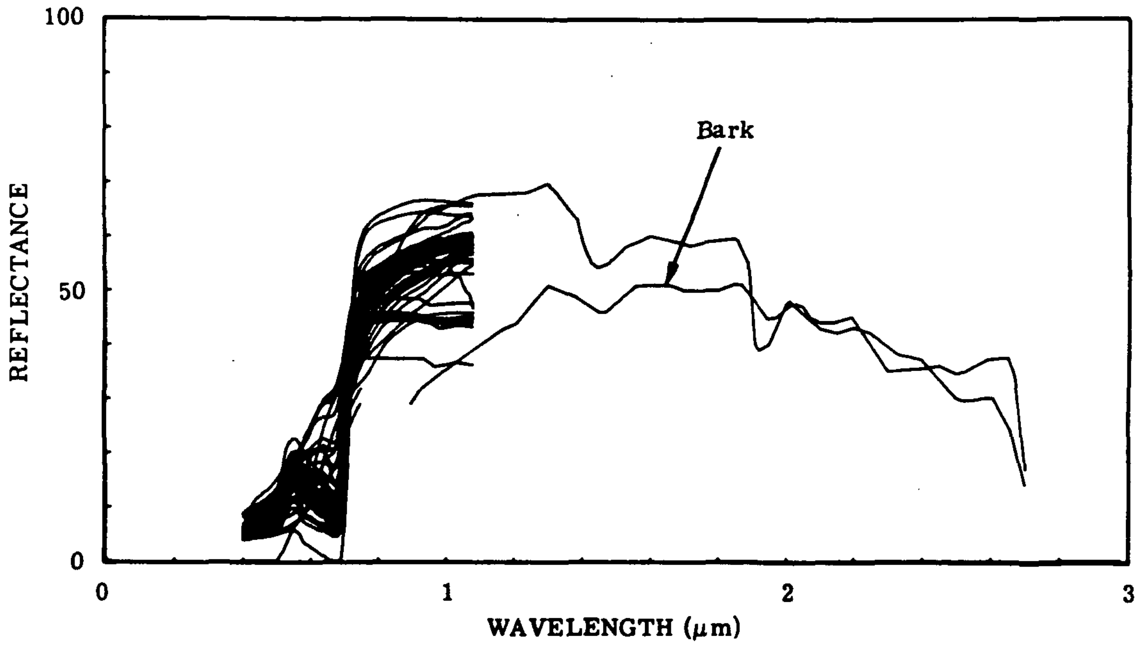
B01818-013 Oak leaf, winter color, top (Quercus borealis maxima), dry
B01818-026 Oak, red, northern (Quercus borealis maxima), bark

67
OAK, GREEN



B03355-026	Oak tree (1-15 June 1952)
B03355-032	Oak tree (16-30 June 1952)
B01176-003	Oak leaf, green
B00829-003	Blackjack oak, top of leaf
B00829-022	Willow oak leaf, top
B00829-050	Chestnut oak leaf, yellow, newly fallen
B00829-052	Laurel oak leaf, top
B01049-011	Quercus vaccinifolia
B20000-282	Oak leaf, upper leaf surface
B20000-283	Oak leaf, lower leaf surface
B20000-294	Oak leaf, upper leaf surface, 26 hr after picking, exposed to sunlight
B20000-295	Oak leaf, lower leaf surface, 26 hr after picking, exposed to sunlight
B20000-543	Red oak, old, upper leaf surface
B20000-544	Red oak, old, lower leaf surface
B20000-551	Red oak leaf, upper leaf surface
B20000-552	Red oak leaf, lower leaf surface

68
WHITE OAK

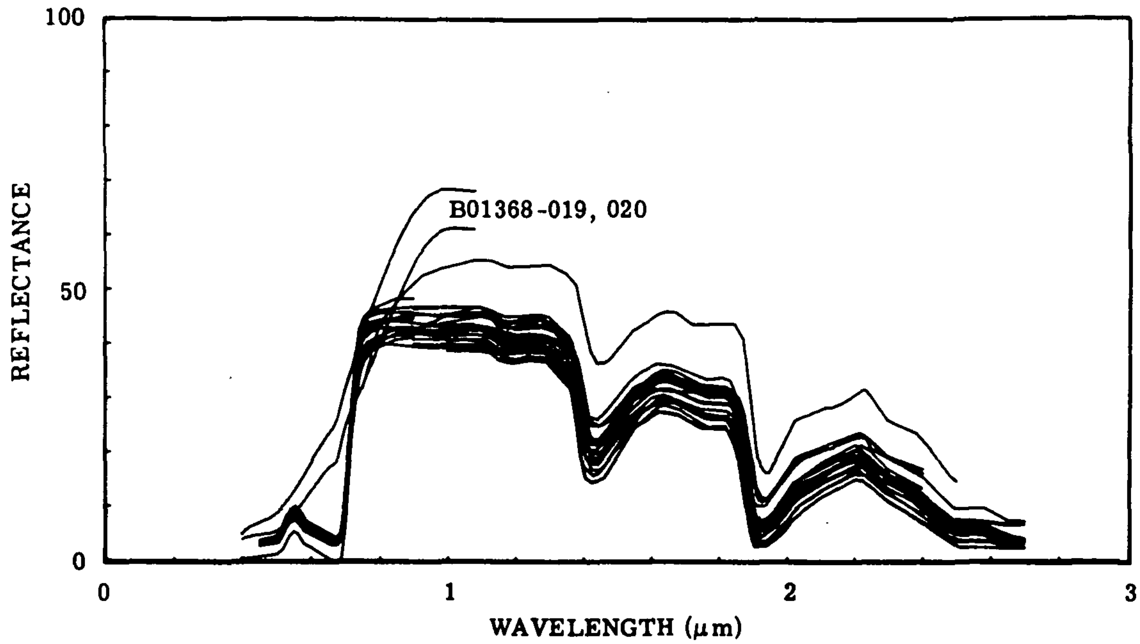


B01353-001	Leaf, White oak, ventral, kept dry, 0.5 hr after picking
B01353-002	Leaf, White oak, ventral, kept dry, 3 hr after picking
B01353-003	Leaf, White oak, ventral, kept dry, 5 hr after picking
B01353-004	Leaf, White oak, ventral, kept dry, 22 hr after picking
B01353-005	Leaf, White oak, ventral, kept dry, 27 hr after picking
B01353-006	Leaf, White oak, ventral, kept dry, 45.5 hr after picking
B01353-007	Leaf, White oak, ventral, kept dry, 51.5 hr after picking
B01353-008	Leaf, White oak, ventral, kept dry, 121 hr after picking
B01353-009	Leaf, White oak, ventral, kept dry, 1 week after picking
B01353-010	Leaf, White oak, ventral, kept dry, 2 weeks after picking
B01353-011	Leaf, White oak, ventral, kept dry, 3 weeks after picking
B01353-012	Leaf, White oak, ventral, kept dry, 4 weeks after picking
B01353-013	Leaf, White oak, ventral, kept dry, 5 weeks after picking
B01353-014	Leaf, White oak, ventral, kept dry, 10 weeks after picking
B01353-015	Leaf, White oak, ventral, kept dry, 12 weeks after picking
B01353-016	Leaf, White oak, ventral, kept dry, 16 weeks after picking
B01353-017	Leaf, White oak, ventral, kept dry, 20 weeks after picking
B01353-018	Leaf, White oak, ventral, kept dry, 24 weeks after picking
B01353-019	Leaf, White oak, ventral, kept dry, 28 weeks after picking

B01353-020	Leaf, White oak, ventral, kept dry, 32 weeks after picking
B01353-021	Leaf, White oak, ventral, kept dry, 36 weeks after picking
B01353-022	Leaf, White oak, ventral, kept dry, 40 weeks after picking
B01353-023	Leaf, White oak, ventral, kept dry, 44 weeks after picking
B01353-024	Leaf, White oak, ventral, kept dry, 48 weeks after picking
B01353-025	Leaf, White oak, ventral, kept dry, 52 weeks after picking
B01353-026	Leaf, White oak, ventral, kept dry, 52 weeks after picking
B01353-027	Leaf, White oak, ventral, kept dry, 52 weeks after picking
B01367-007	Leaf, in container 17 hr, White oak, ventral side
B01367-008	Leaf, in container 17 hr, White oak, dorsal side
B01339-002	Outer bark, White oak, sample No. 95
B01368-010	Leaf, White oak, red brown, ventral
B01368-011	Leaf, White oak, red brown, dorsal
B01368-021	Leaf, White oak, ventral side
B01368-022	Leaf, White oak, green, ventral side
B01368-023	Leaf, White oak, reddish, ventral side
B00829-044	White oak leaf, top, sere, brown
B00829-065	White oak bark
B03333-003	White oak leaves, 0.5 hr after picking, Spring 1964
B03333-004	White oak leaves, 0.5 hr after picking, Spring 1964
B03333-005	White oak leaves, 0.5 hr after picking, Spring 1964
B03333-006	White oak leaves, 0.5 hr after picking, Spring 1964
B03333-007	White oak leaves, 0.5 hr after picking, Fall 1964
B03333-008	White oak leaves, 0.5 hr after picking, Fall 1964
B03333-009	White oak leaves, 0.5 hr after picking, Fall 1964
B03333-010	White oak leaves, 0.5 hr after picking, Fall 1964
B03333-011	White oak leaves, 0.5 hr after picking, Fall 1964
B05272-004	White oak leaves

69

BLACK OAK

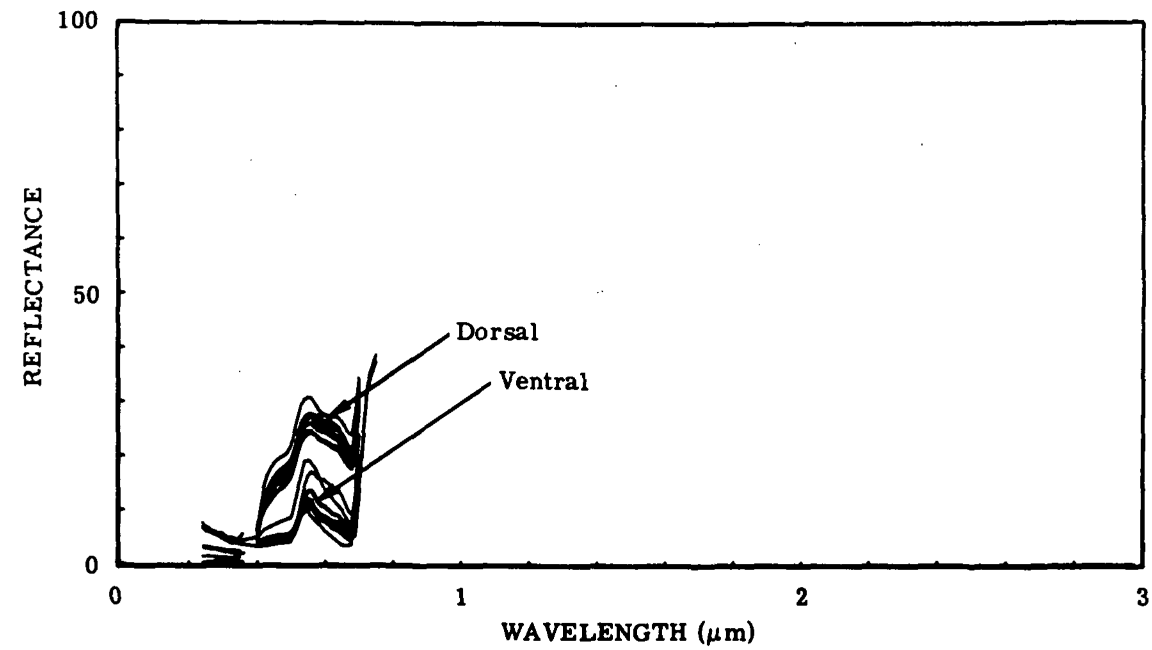


B01368-019	Leaf, Black oak, ventral side
B01368-020	Leaf, Black oak, ventral side
B20000-286	Black oak leaf, upper leaf surface
B20000-287	Black oak leaf, lower leaf surface
B20000-290	Black oak leaf, upper surface, 1 hr after picking
B20000-291	Black oak leaf, lower surface, 1 hr after picking
B20000-296	Black oak leaf, upper leaf surface, 26 hr after picking, exposed to sunlight
B20000-297	Black oak leaf, lower leaf surface, 26 hr after picking, exposed to sunlight
B20000-302	Black oak leaf, bleached and dried
B05272-001	Black oak leaves
B20000-415	Black oak, upper leaf surface, green, picked from branch that was removed from tree 4 hr previously
B20000-416	Black oak, upper leaf surface, green, picked from branch that was removed from tree 4 hr previously
B20000-417	Black oak, upper leaf surface, green, picked from branch that was removed from tree 4 hr previously
B20000-418	Black oak, upper leaf surface, green, picked from branch that was removed from tree 4 hr previously
B20000-429	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors

B20000-430	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-431	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-432	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-433	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-434	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-435	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-436	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-437	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-438	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-439	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-440	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-441	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-442	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-443	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-444	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-445	Black oak, upper leaf surface, bleached
B20000-446	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-447	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-448	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors
B20000-449	Black oak, upper leaf surface, after 10 hr exposure to sunlight and 24 hr outdoors

70

BURR OAK

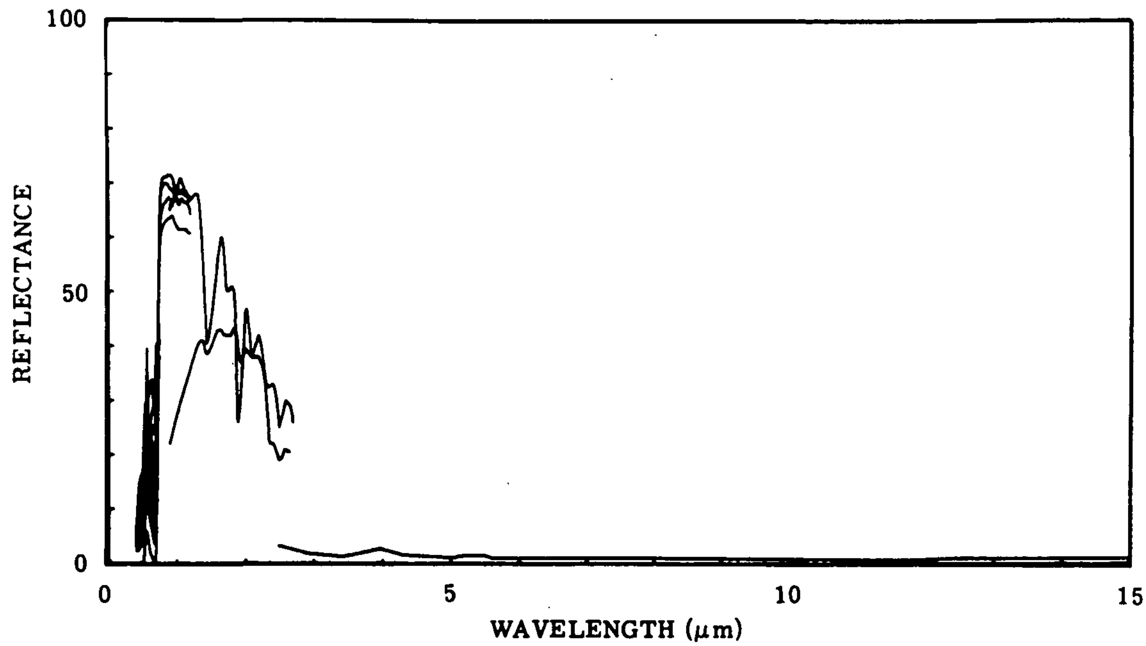


B03374-617	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 3 August 1961
B03374-618	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 8 August 1961
B03374-619	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 15 August 1961
B03374-620	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 21 August 1961
B03374-621	Burr Oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 28 August 1961
B03374-622	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 5 September 1961
B03374-623	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 11 September 1961
B03374-624	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 18 September 1961
B03374-625	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 26 September 1961
B03374-626	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 2 October 1961
B03374-627	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 9 October 1961

B03374-628	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of upper leaf surface, 25 October 1961
B03374-629	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 3 August 1961
B03374-630	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 8 August 1961
B03374-631	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 15 August 1961
B03374-632	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 21 August 1961
B03374-633	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 28 August 1961
B03374-634	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 5 September 1961
B03374-635	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 11 September 1961
B03374-636	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 18 September 1961
B03374-637	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 26 September 1961
B03374-638	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 2 October 1961
B03374-639	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 9 October 1961
B03374-640	Burr oak (Quercus macrocarpa Michx.), crown position, south side, upper one-third of lower leaf surface, 25 October 1961
B20000-126	Burr oak, upper leaf surface, before picking
B20000-127	Burr oak, lower leaf surface, before picking
B20000-154	Burr oak, upper leaf surface, before picking
B20000-155	Burr oak, lower leaf surface, before picking
B20000-156	Burr oak, upper leaf surface, before picking
B20000-157	Burr oak, lower leaf surface, before picking
B20000-158	Burr oak, upper leaf surface, before picking
B20000-159	Burr oak, lower leaf surface, before picking

71

TULIP TREE



B01368-012	Leaf, Tulip poplar, yellow, ventral
B01368-013	Leaf, Tulip poplar, yellow, dorsal
B00829-040	Tulip tree, yellow leaf, top, fallen
B00829-046	Yellow locust, picked August 4
B00829-047	Yellow locust, picked August 4
B00829-076	Tulip tree bark, outer layer
B00829-092	Tulip poplar, picked August 4
B00829-093	Tulip poplar, picked August 4
B03374-153	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 2 May 1960
B03374-154	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 6 May 1960
B03374-155	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 13 May 1960
B03374-156	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 23 May 1960
B03374-157	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 27 May 1960
B03374-158	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 3 June 1960
B03374-159	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 10 June 1960

B03374-160	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 17 June 1960
B03374-161	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 24 June 1960
B03374-162	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 8 July 1960
B03374-163	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 15 July 1960
B03374-164	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 22 July 1960
B03374-165	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 29 July 1960
B03374-166	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 5 August 1960
B03374-167	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 22 August 1960
B03374-168	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 26 August 1960
B03374-169	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 2 September 1960
B03374-170	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 9 September 1960
B03374-171	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 16 September 1960
B03374-172	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 21 September 1960
B03374-173	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 28 September 1960
B03374-174	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 5 October 1960
B03374-175	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 12 October 1960
B03374-176	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 20 October 1960
B03374-177	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 26 October 1960
B03374-178	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 2 November 1960
B03374-179	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 2 May 1960
B03374-180	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 6 May 1960
B03374-181	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 13 May 1960

B03374-182	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 23 May 1960
B03374-183	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 27 May 1960
B03374-184	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 3 June 1960
B03374-185	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 10 June 1960
B03374-186	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 17 June 1960
B03374-187	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 24 June 1960
B03374-188	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 8 July 1960
B03374-189	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 15 July 1960
B03374-190	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 22 July 1960
B03374-191	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 29 July 1960
B03374-192	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 5 August 1960
B03374-193	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 22 August 1960
B03374-194	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 26 August 1960
B03374-195	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 2 September 1960
B03374-196	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 9 September 1960
B03374-197	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 16 September 1960
B03374-198	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 21 September 1960
B03374-199	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 28 September 1960
B03374-200	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 5 October 1960
B03374-201	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 12 October 1960
B03374-202	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 20 October 1960
B03374-203	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 26 October 1960

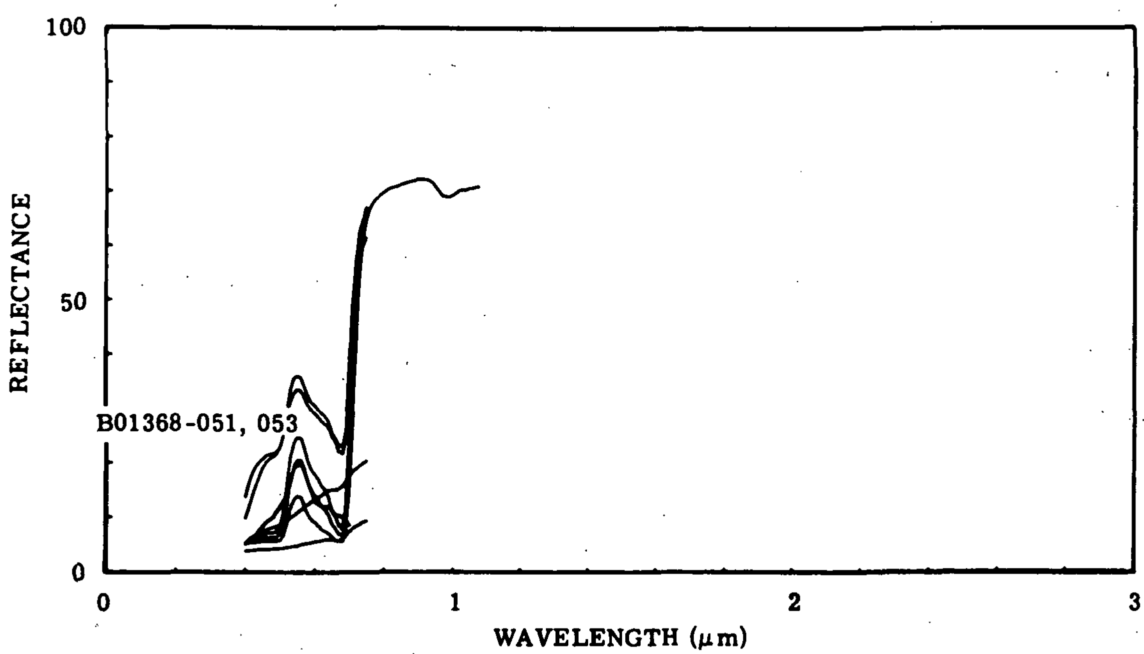
B03374-204	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 2 November 1960
B03374-567	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 15 May 1961
B03374-568	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 24 May 1961
B03374-569	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 29 May 1961
B03374-570	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 5 June 1961
B03374-571	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 12 June 1961
B03374-572	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 19 June 1961
B03374-573	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 26 June 1961
B03374-574	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 3 July 1961
B03374-575	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 10 July 1961
B03374-576	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 17 July 1961
B03374-577	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 24 July 1961
B03374-578	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 31 July 1961
B03374-579	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 7 August 1961
B03374-580	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 14 August 1961
B03374-581	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 21 August 1961
B03374-582	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 28 August 1961
B03374-583	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 5 September 1961
B03374-584	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 12 September 1961
B03374-585	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 19 September 1961
B03374-586	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 27 September 1961
B03374-587	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 3 October 1961

B03374-588	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 10 October 1961
B03374-589	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 16 October 1961
B03374-590	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface 24 October 1961
B03374-591	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of upper leaf surface, 2 November 1961
B03374-592	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 15 May 1961
B03374-593	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 24 May 1961
B03374-594	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 29 May 1961
B03374-595	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 5 June 1961
B03374-596	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 12 June 1961
B03374-597	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 19 June 1961
B03374-598	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 26 June 1961
B03374-599	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 3 July 1961
B03374-600	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 10 July 1961
B03374-601	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 17 July 1961
B03374-602	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 24 July 1961
B03374-603	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 31 July 1961
B03374-604	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 7 August 1961
B03374-605	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 14 August 1961
B03374-606	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 21 August 1961
B03374-607	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 28 August 1961
B03374-608	Yellow poplar (Liriodendron tulipifera L.), crown positiion, south side, upper one-third of lower leaf surface, 5 September 1961
B03374-609	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 12 September 1961

B03374-610	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 19 September 1961
B03374-611	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 27 September 1961
B03374-612	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 3 October 1961
B03374-613	Yellow poplar (Lirodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 10 October 1961
B03374-614	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 16 October 1961
B03374-615	Yellow poplar (Liriodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 24 October 1961
B03374-616	Yellow poplar (Lirodendron tulipifera L.), crown position, south side, upper one-third of lower leaf surface, 2 November 1961
B05272-002	Tulip tree leaves
B04696-045	Tulip poplar leaf (Liriodendron tulipifera), upper leaf surface

72

POPLAR

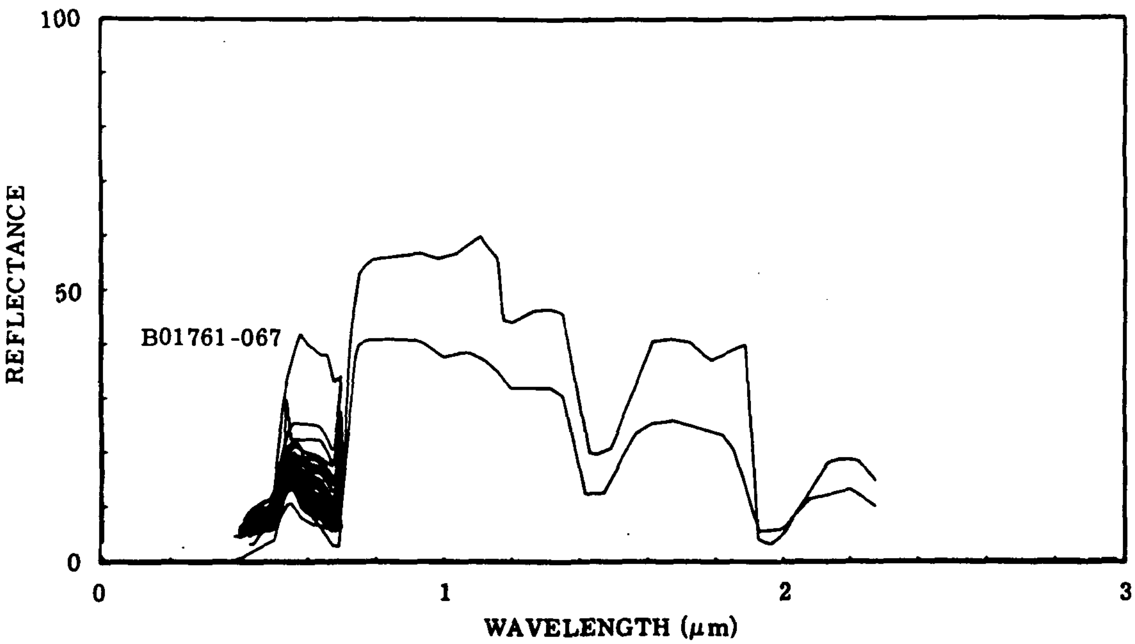


B01368-048	Leaf, Balsam poplar, black, ventral
B01368-049	Leaf, Balsam poplar, black, dorsal
B01368-050	Leaf, Balsam poplar, green, ventral
B01368-051	Leaf, Balsam poplar, green, dorsal
B01368-052	Leaf, Large Tooth poplar, green, ventral

B01368-053	Leaf, Large Tooth poplar, green, dorsal
B01368-054	Leaf, Large Tooth poplar, white, ventral
B01368-055	Leaf, Large Tooth poplar, white, dorsal
B01368-067	Leaf, Balsam poplar, ventral side
B01337-010	Balsam poplar
B01761-028	White poplar (Populus alba), upper leaf surface
B01761-056	White poplar (Populus alba), upper leaf surface
B01761-057	White poplar (Populus alba), lower leaf surface

73

COTTONWOOD



B03374-053	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 2 May 1960
B03374-054	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 6 May 1960
B03374-055	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 13 May 1960
B03374-056	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 23 May 1960
B03374-057	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 27 May 1960
B03374-058	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 6 June 1960
B03374-059	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 10 June 1960

B03374-060	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 17 June 1960
B03374-061	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 24 June 1960
B03374-062	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 8 July 1960
B03374-063	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 15 July 1960
B03374-064	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 22 July 1960
B03374-065	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 29 July 1960
B03374-066	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 5 August 1960
B03374-067	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 19 August 1960
B03374-068	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 26 August 1960
B03374-069	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 2 September 1960
B03374-070	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 9 September 1960
B03374-071	Cottonwood (Populus deltoides Marsh,), crown position, south side, upper one-third of upper leaf surface, 16 September 1960
B03374-072	Cottonwood (Populus deltoides Marsh,), crown position, south side, upper one-third of upper leaf surface, 21 September 1960
B03374-073	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 28 September 1960
B03374-074	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 5 October 1960
B03374-075	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 12 October 1960
B03374-076	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 20 October 1960
B03374-077	Cottonwood (Populus deltoides Marsh.), crown position, south side, lower one-third of upper leaf surface, 2 May 1960
B03374-078	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 6 May 1960
B03374-079	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 13 May 1960
B03374-080	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 23 May 1960
B03374-081	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 27 May 1960

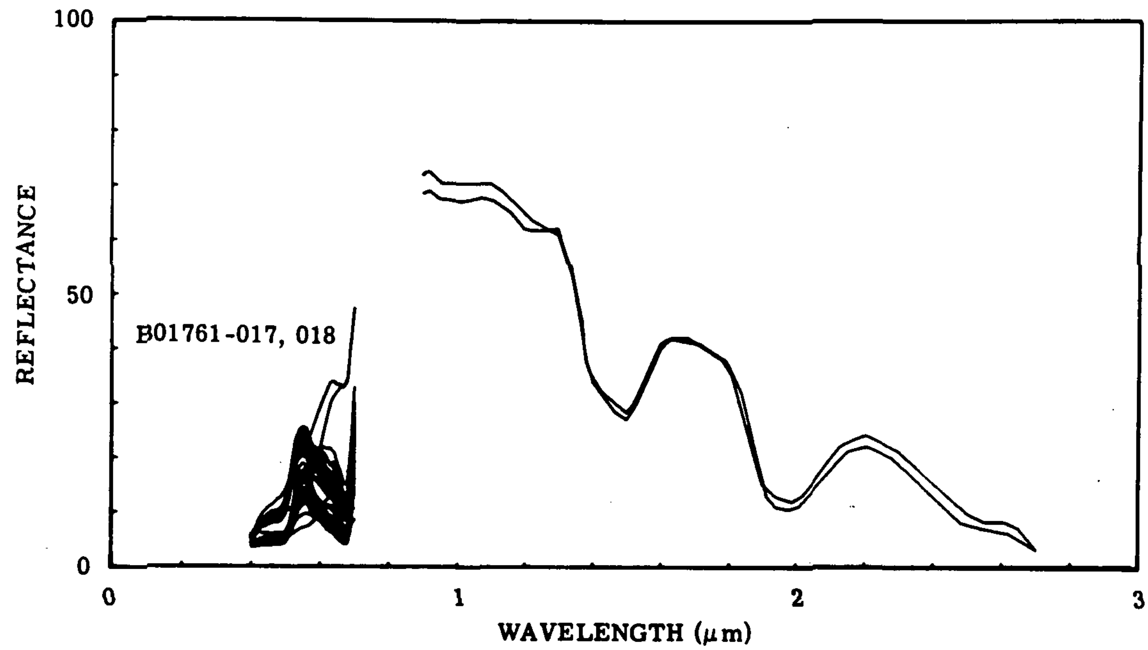
B03374-082	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 6 June 1960
B03374-083	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 10 June 1960
B03374-084	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 17 June 1960
B03374-085	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 24 June 1960
B03374-086	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 8 July 1960
B03374-087	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 15 July 1960
B03374-088	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 22 July 1960
B03374-089	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 29 July 1960
B03374-090	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 5 August 1960
B03374-091	Cottonwood (Populus deltiodes Marsh.), crown position, south side, upper one-third of lower leaf surface, 19 August 1960
B03374-092	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 26 August 1960
B03374-093	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 2 September 1960
B03374-094	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 9 September 1960
B03374-095	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 16 September 1960
B03374-096	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 21 September 1960
B03374-097	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 28 September 1960
B03374-098	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 5 October 1960
B03374-099	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 12 October 1960
B03374-100	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 20 October 1960
B03374-475	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 15 May 1961
B03374-476	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 28 May 1961
B03374-477	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 1 June 1961

B03374-478	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 7 June 1961
B03374-479	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 14 June 1961
B03374-480	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 21 June 1961
B03374-481	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 26 June 1961
B03374-482	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 3 July 1961
B03374-483	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 10 July 1961
B03374-484	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 17 July 1961
B03374-485	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 25 July 1961
B03374-486	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 31 July 1961
B03374-487	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 7 August 1961
B03374-488	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 14 August 1961
B03374-489	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 21 August 1961
B03374-490	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 28 August 1961
B03374-491	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 6 September 1961
B03374-492	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 11 September 1961
B03374-493	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 18 September 1961
B03374-494	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 26 September 1961
B03374-495	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 2 October 1961
B03374-496	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of upper leaf surface, 9 October 1961
B03374-497	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 15 May 1961
B03374-498	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 23 May 1961
B03374-499	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 1 June 1961

C-3

B03374-500	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 7 June 1961
B03374-501	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 14 June 1961
B03374-502	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 21 June 1961
B03374-503	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 26 June 1961
B03374-504	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one third of lower leaf surface, 3 July 1961
B03374-505	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 10 July 1961
B03374-506	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 17 July 1961
B03374-507	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 25 July 1961
B03374-508	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 31 July 1961
B03374-509	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 7 August 1961
B03374-510	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 14 August 1961
B03374-511	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 21 August 1961
B03374-512	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 28 August 1961
B03374-513	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 6 September 1961
B03374-514	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 11 September 1961
B03374-515	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 18 September 1961
B03374-516	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 26 September 1961
B03374-517	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 2 October 1961
B03374-518	Cottonwood (Populus deltoides Marsh.), crown position, south side, upper one-third of lower leaf surface, 9 October 1961
B01761-040	Cottonwood (Populus deltoides), young, upper leaf surface
B01761-041	Cottonwood (Populus deltoides), old, upper leaf surface
B01761-067	Cottonwood (Populus deltoides), upper leaf surface
B03070-001	Populus deltoides
B03070-002	Populus deltoides

74
SWEET GUM



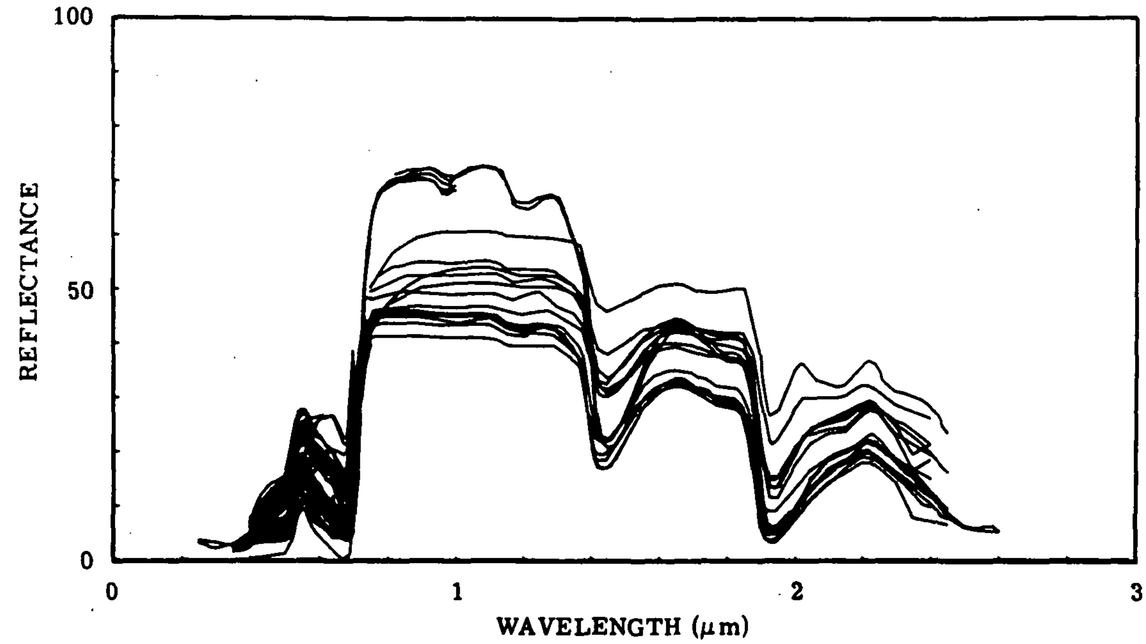
B00829-024	Sweetgum leaf, top
B00829-025	Sweetgum leaf, back
B03374-349	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 23 May 1960
B03374-350	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 31 May 1960
B03374-351	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 3 June 1960
B03374-352	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 10 June 1960
B03374-353	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 17 June 1960
B03374-354	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 27 June 1960
B03374-355	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 8 July 1960
B03374-356	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 18 July 1960
B03374-357	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 22 July 1960
B03374-358	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 29 July 1960

B03374-359	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 5 August 1960
B03374-360	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-thrid of upper leaf surface, 2 August 1960
B03374-361	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 26 August 1960
B03374-362	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 2 September 1960
B03374-363	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 9 September 1960
B03374-364	Sweetgum (Liquidambar sytraciflua L.), crown position, south side, upper one-third of upper leaf surface, 16 September 1960
B03374-365	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 21 September 1960
B03374-366	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 28 September 1960
B03374-367	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 5 October 1960
B03374-368	Sweetgum (Liquidambar stryaciflua L.), crown position, south side, upper one-third of upper leaf surface, 12 October 1960
B03374-369	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 20 October 1960
B03374-370	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 26 October 1960
B03374-371	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 2 November 1960
B03374-372	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of upper leaf surface, 10 November 1960
B03374-373	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 23 May 1960
B03374-374	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 31 May 1960
B03374-375	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower oeaf surface, 3 June 1960
B03374-376	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 10 June 1960
B03374-377	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-thire of lower leaf surface, 17 June 1960
B03374-378	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 27 June 1960
B03374-379	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 8 July 1960
B03374-380	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 18 July 1960

B03374-381	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 22 July 1960
B03374-382	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 29 July 1960
B03374-383	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 5 August 1960
B03374-384	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 22 August 1960
B03374-385	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 26 August 1960
B03374-386	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 2 September 1960
B03374-387	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 9 September 1960
B03374-388	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 16 September 1960
B03374-389	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 21 September 1960
B03374-390	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 28 September 1960
B03374-391	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 5 October 1960
B03374-392	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 12 October 1960
B03374-393	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 20 October 1960
B03374-394	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 26 October 1960
B03374-395	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 2 November 1960
B03374-396	Sweetgum (Liquidambar styraciflua L.), crown position, south side, upper one-third of lower leaf surface, 10 November 1960
B01761-017	Sweetgum (Liquidambar styraciflua), upper leaf surface
B01761-018	Sweetgum (Liquidambar styraciflua), lower leaf surface

75

SYCAMORE, LIVE



B03374-205	Sycamore (Platanus occidentalis L.) crown position, south side, upper one-third of upper leaf surface, 6 May 1960
B03374-206	Sycamore (Platanus occidentalis L.) crown position, south side, upper one-third of upper leaf surface, 13 May 1960
B03374-207	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 23 May 1960
B03374-208	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 27 May 1960
B03374-209	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 6 June 1960
B03374-210	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 10 June 1960
B03374-211	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 17 June 1960
B03374-212	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 24 June 1960
B03374-213	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 8 July 1960
B03374-214	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 15 July 1960
B03374-215	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 22 July 1960

B03374-216	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 29 July 1960
B03374-217	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 5 August 1960
B03374-218	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 19 August 1960
B03374-219	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 26 August 1960
B03374-220	Sycamore (Platanus occidentalis L.), crown position, south side, upper one third of upper leaf surface, 2 September 1960
B03374-221	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 9 September 1960
B03374-222	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 16 September 1960
B03374-223	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 21 September 1960
B03374 224	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 28 September 1960
B03374-225	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 5 October 1960
B03374-226	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 12 October 1960
B03374-227	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 20 October 1960
B03374-228	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 26 October 1960
B03374-229	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 2 November 1960
B03374-230	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 10 November 1960
B03374-231	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 6 May 1960
B03374-232	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 13 May 1960
B03374-233	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 23 May 1960
B03374-234	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 27 May 1960
B03374-235	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 6 June 1960
B03374-236	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 10 June 1960
B03374-237	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 17 June 1960

B03374-238	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 24 June 1960
B03374-239	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 8 July 1960
B03374-240	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 15 July 1960
B03374-241	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 22 July 1960
B03374-242	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 29 July 1960
B03374-243	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 5 August 1960
B03374-244	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 19 August 1960
B03374-245	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 26 August 1960
B03374-246	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 2 September 1960
B03374-247	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 9 September 1960
B03374-248	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 16 September 1960
B03374-249	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 21 September 1960
B03374-250	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 28 September 1960
B03374-251	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 5 October 1960
B03374-252	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 12 October 1960
B03374-253	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 20 October 1960
B03374-254	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 26 October 1960
B03374-255	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 2 November 1960
B03374-256	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 10 November 1960
B03374-641	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 17 May 1961
B03374-642	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 23 May 1961
B03374-643	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 1 June 1961

B03374-644	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 5 June 1961
B03374-645	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 12 June 1961
B03374-646	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 20 June 1961
B03374-647	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 27 June 1961
B03374-648	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 5 July 1961
B03374-649	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 11 July 1961
B03374-650	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 18 July 1961
B03374-651	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 25 July 1961
B03374-652	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 1 August 1961
B03374-653	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 8 August 1961
B03374-654	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 15 August 1961
B03374-655	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 22 August 1961
B03374-656	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 29 August 1961
B03374-657	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 7 September 1961
B03374-658	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 13 September 1961
B03374-659	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 19 September 1961
B03374-660	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 27 September 1961
B03374-661	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 3 October 1961
B03374-662	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 10 October 1961
B03374-663	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 16 October 1961
B03374-664	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 24 October 1961
B03374-665	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of upper leaf surface, 2 November 1961

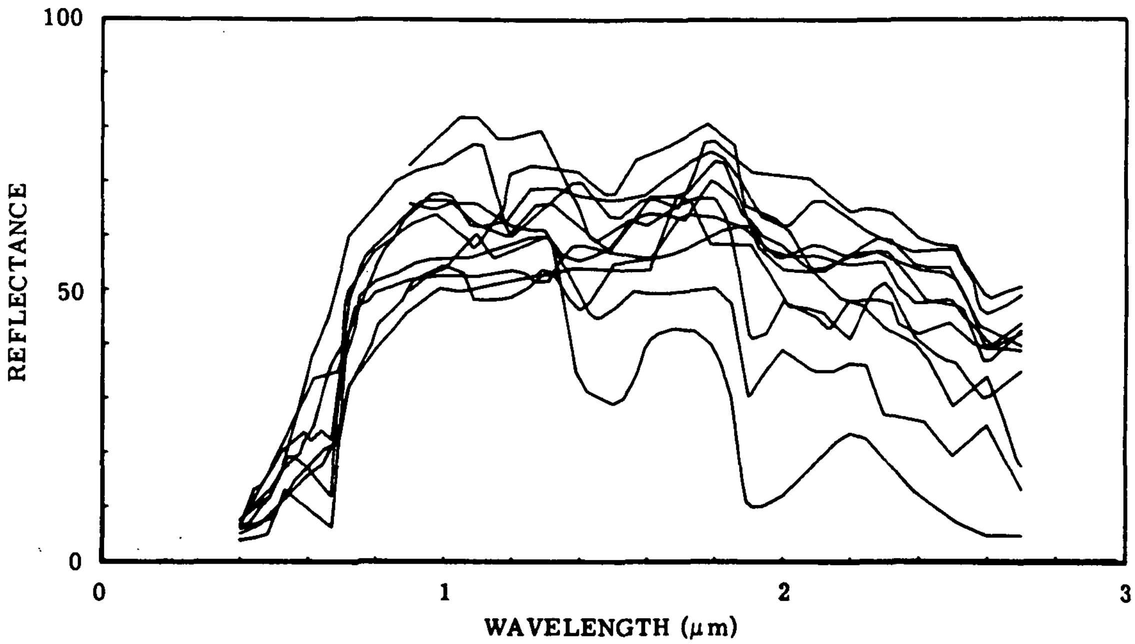
B03374-666	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 17 May 1961
B03374-667	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 23 May 1961
B03374-668	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 1 June 1961
B03374-669	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 5 June 1961
B03374-670	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 12 June 1961
B03374-671	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 20 June 1961
B03374-672	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 27 June 1961
B03374-673	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 5 July 1961
B03374-674	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 11 July 1961
B03374-675	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 18 July 1961
B03374-676	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 25 July 1961
B03774-677	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 1 August 1961
B03374-678	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 8 August 1961
B03374-679	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 15 August 1961
B03374-680	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 22 August 1961
B03374-681	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 29 August 1961
B03374-682	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 7 September 1961
B03374-683	Sycamore (platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 13 September 1961
B03374-684	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 19 September 1961
B03374-685	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 27 September 1961
B03374-686	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 3 October 1961
B03374-687	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 10 October 1961

B03374-688	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 16 October 1961
B03374-689	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 24 October 1961
B03374-690	Sycamore (Platanus occidentalis L.), crown position, south side, upper one-third of lower leaf surface, 2 November 1961
B20000-181	Sycamore, upper leaf surface, before picking
B20000-182	Sycamore, lower leaf surface, before picking
B20000-183	Sycamore, upper leaf surface, 10 min after picking
B20000-184	Sycamore, lower leaf surface, 10 min after picking
B20000-315	Sycamore, upper leaf surface, from a branch cut and exposed to sunlight 5 days
B20000-316	Sycamore, upper leaf surface, 1 hr after picking
B20000-317	Sycamore, upper leaf surface, leaf was picked and put in an evacuated bell jar for 30 min
B20000-318	Sycamore, upper leaf surface, from a branch cut and exposed to sunlight 5 days
B20000-319	Sycamore, upper leaf surface, 1 hr after picking
B20000-320	Sycamore, upper leaf surface, leaf was picked and put in an evacuated bell jar for 30 min
B20000-321	Sycamore, upper leaf surface, 1 hr after picking
B20000-322	Sycamore, lower leaf surface, 1 hr after picking
B20000-325	Sycamore, upper leaf surface, from a branch cut and exposed to sunlight 4 hr
B20000-326	Sycamore, upper leaf surface, 1 min after picking
B20000-327	Sycamore, upper leaf surface, from a branch cut and exposed to sunlight 4 hr
B20000-328	Sycamore, lower leaf surface, from a branch cut and exposed to sunlight 4 hr
B20000-329	Sycamore, upper leaf surface, from a branch cut 26 hr and exposed to sunlight 1 day
B20000-330	Sycamore, lower leaf surface, from a branch cut 26 hr and exposed to sunlight 1 day
B20000-331	Sycamore, upper leaf surface, from a branch cut 26 hr and exposed to sunlight 1 day
B20000-332	Sycamore, lower leaf surface, from a branch cut 26 hr and exposed to sunlight 1 day
B20000-333	Sycamore, upper leaf surface, from a branch cut and exposed to sunlight 48 hr
B20000-334	Sycamore, lower leaf surface, from a branch cut and exposed to sunlight 48 hr
B20000-335	Sycamore, upper leaf surface, from a branch cut and exposed to sunlight 48 hr

B20000-336	Sycamore, lower leaf surface, from a branch cut and exposed to sunlight 48 hr
B05272-006	Sycamore leaves (Summer, 1961)
B20001-313	Sycamore leaves, freshly picked, 4 leaves thick, upper leaf surface
B20001-319	Sycamore leaves, freshly picked, 4 leaves thick, upper leaf surface
B20001-325	Sycamore leaves, freshly picked, 4 leaves thick, upper leaf surface
B20001-331	4 fresh sycamore leaves
B20001-337	4 fresh sycamore leaves

76

SYCAMORE

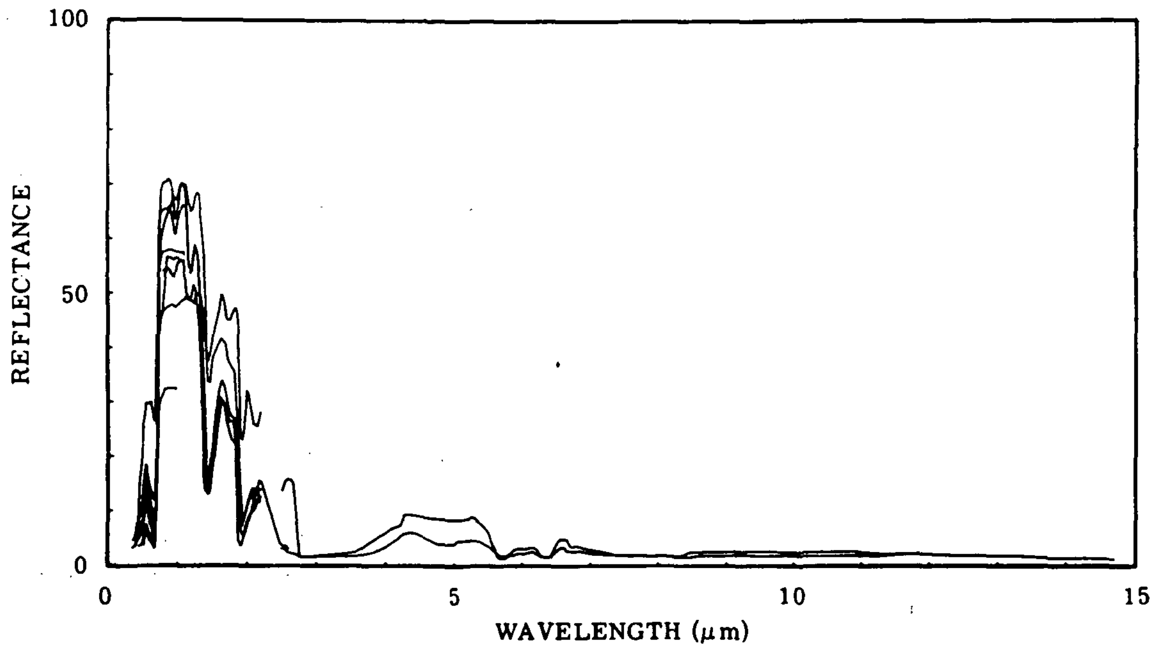


B00829-001	Sycamore leaf, fallen, brown, drying
B00829-002	Sycamore bark, shed from trunk of tree
B00829-054	Sycamore leaf, top
B04803-001	Sycamore, green, lower leaf surface
B04803-002	Sycamore, green, lower leaf surface
B04803-003	Sycamore, green, upper leaf surface
B04803 004	Sycamore, green, upper leaf surface
B04803 005	Sycamore leaves, newly fallen, upper leaf surface
B04803-006	Sycamore leaves, newly fallen, upper leaf surface
B04803-007	Sycamore leaves, newly fallen, lower leaf surface
B04803-008	Sycamore leaves, newly fallen, lower leaf surface

B04803-009	Sycamore leaves, weathered, upper leaf surface
B04803-010	Sycamore leaves, weathered, upper leaf surface
B04803-011	Sycamore leaves, weathered, lower leaf surface
B04803-012	Sycamore leaves, weathered, lower leaf surface
B04803-013	Sycamore leaves, weathered, lower leaf surface
B04803-014	Sycamore leaves, weathered, lower leaf surface
B04803-015	Sycamore leaves, weathered, upper leaf surface
B04803-016	Sycamore leaves, weathered, upper leaf surface

77

PINE

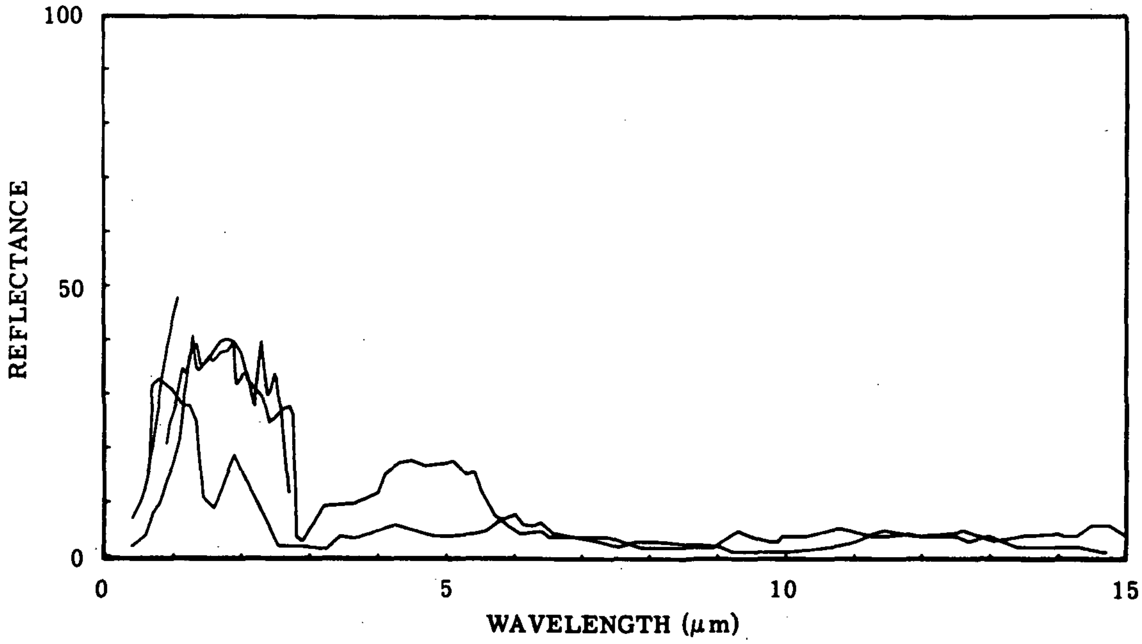


B01049-023	Pine forest, north-facing
B01049-024	Pine forest, west-facing
B03355-019	Pine needles (Summer, 1951)
B03355-025	Pine tree(16-31 May 1952)
B03355-031	Pine tree (1-15 June 1952)
B03355-037	Pine tree (16-30 June 1952)
B03070-003	Pinus strobus
B03333-012	Pinus ponderosa, healthy
B03333-013	Pinus ponderosa, diseased (attack 1964)
B03333-014	Pinus ponderosa, diseased (attack 1963)
B03333-019	Ponderosa pine needles, healthy

B03333-020	Ponderosa pine needles, diseased (attack 1963)
B20000-540	White pine
B20000-550	White pine (Pinus strobus)

78

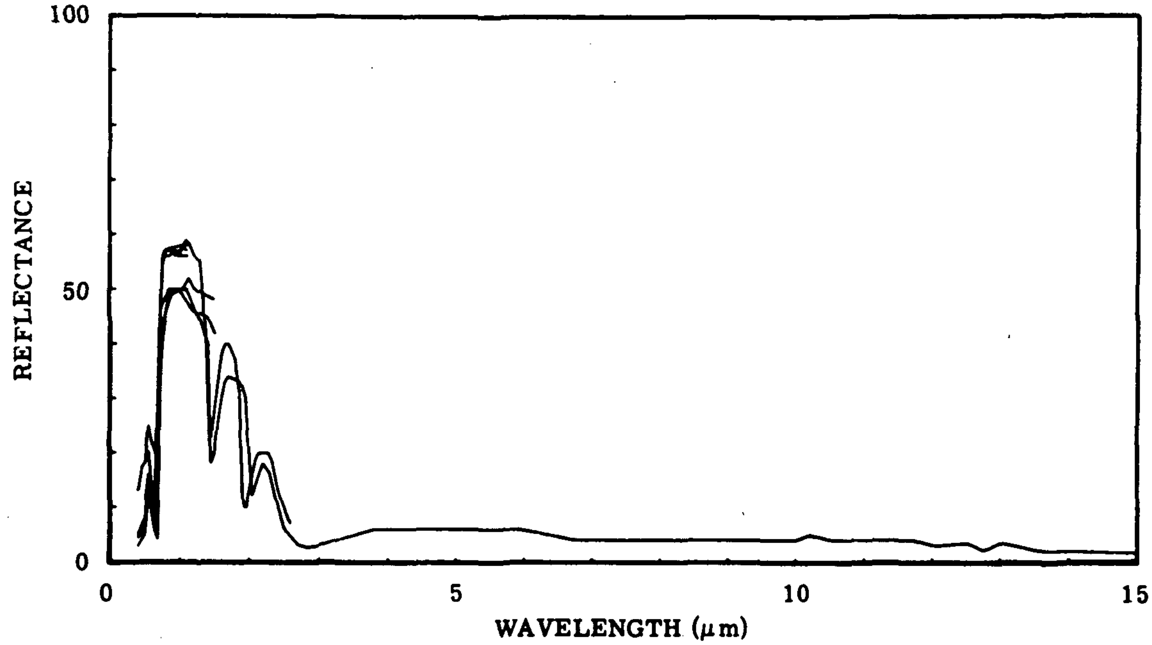
PINE BARK



B01339-001	Outer bark Scrub pine, sample No. 93
B00829-098	Sugar pine bark
B01818-014	Pine, Jack, twigs (Pinus banksiana, Northeastern America)
B01818-027	Pine, Jack (Pinus banksiana) bark

79

RED PINE



B03374-001	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 3 May 1960
B03374-002	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 17 May 1960
B03374-003	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 31 May 1960
B03374-004	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year old needles, 6 June 1960
B03374-005	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 15 June 1960
B03374-006	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 20 June 1960
B03374-007	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 27 June 1960
B03374-008	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 11 July 1960
B03374-009	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 18 July 1960
B03374-010	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 25 July 1960
B03374-011	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 1 August 1960

B03374-012	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 8 August 1960
B03374-013	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 22 August 1960
B03374-014	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 26 August 1960
B03374-015	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 6 September 1960
B03374-016	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 12 September 1960
B03374-017	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 19 September 1960
B03374-018	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 27 September 1960
B03374-019	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 4 October 1960
B03374-020	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 11 October 1960
B03374-021	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 18 October 1960
B03374-022	Red pine (Pinus resinosa Ait.), crown position, south side, upper-one third of new needles, 25 October 1960
B03374-023	Red pine (Pinus resinosa Ait.), crown poisition, south side, upper one-third of new needles, 1 November 1960
B03374-024	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 10 November 1960
B03374-025	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 16 November 1960
B03374-026	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 22 November 1960
B03374-397	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 2 February 1961
B03374-398	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 4 March 1961
B03374-399	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 26 April 1961
B03374-400	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-thire of one-year-old needles, 16 May 1961
B03374-401	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 26 May 1961
B03374-402	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 31 May 1961
B03374-403	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 7 June 1961

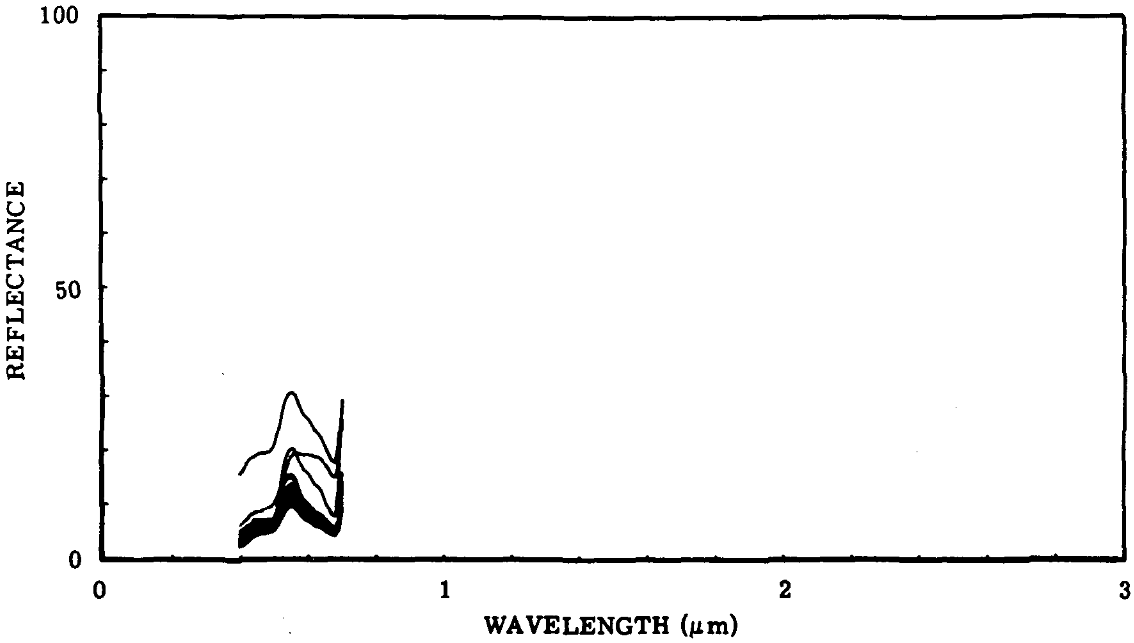
B03374-404	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 14 June 1961
B03374-405	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 22 June 1961
B03374-406	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 28 June 1961
B03374-407	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 6 July 1961
B03374-408	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 12 July 1961
B03374-409	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 19 July 1961
B03374-410	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 26 July 1961
B03374-411	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of one-year-old needles, 2 August 1961
B03374-412	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-thire of one-year-old needles, 11 August 1961
B03374-413	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 14 June 1961
B03374-414	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 22 June 1961
B03374-415	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 28 June 1961
B03374-416	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 6 July 1961
B03374-417	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 12 July 1961
B03374-418	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 19 July 1961
B03374-419	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 26 July 1961
B03374-420	Red pine (Pinus resinosa Ait., crown position, south side, upper one-third of new needles, 2 August 1961
B03374-421	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 11 August 1961
B03374-422	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 16 August 1961
B03374-423	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 24 August 1961
B03374-424	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 29 August 1961
B03374-425	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 6 September 1961

B03374-426	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 19 September 1961
B03374-427	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 25 September 1961
B03374-428	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 3 October 1961
B03374-429	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 10 October 1961
B03374-430	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 17 October 1961
B03374-431	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 25 October 1961
B03374-432	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 3 November 1961
B03374-433	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 8 November 1961
B03374-434	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 17 November 1961
B03374-435	Red pine (Pinus resinosa Ait.), crown position, south side, upper one-third of new needles, 7 December 1961
B03559-001	Pinus resinosa, needles, sample No. 217
B03559-004	Pinus resinosa, needles, sample No. 219
B03559-007	Pinus resinosa, needles, sample No. 223
B03559-010	Pinus resinosa, needles, sample No. 240
B03559-013	Pinus resinosa, needles, sample No. 242
B03559-016	Pinus resinosa, needles, sample No. 248
B03559-019	Pinus resinosa, needles, sample No. 204, healthy
B03559-022	Pinus resinosa, needles, sample No. 205, healthy
B03559-025	Pinus resinosa, needles, sample No. 206, healthy
B03559-028	Pinus resinosa, needles, sample No. 207, poisoned with sodium arsenite
B03559-031	Pinus resinosa, needles, sample No. 208, poisoned with sodium arsenite
B03559-034	Pinus resinosa, needles, brown portion of needles, new area, sample No. 208, poisoned with sodium arsenite
B03559-035	Pinus resinosa, needles, sample No. 209, poisoned with sodium arsenite
B03559-038	Pinus resinosa, needles, sample No. 210, healthy
B03559-041	Pinus resinosa, needles, sample No. 211, healthy
B03559-044	Pinus resinosa, needles, sample No. 212, healthy
B03559-047	Pinus resinosa, needles, sample No. 213, poisoned with sodium arsenite
B03559-050	Pinus resinosa, needles, sample No. 214, poisoned with sodium arsenite
B03559-053	Pinus resinosa, needles, sample No. 215, poisoned with sodium arsenite
B03559-056	Pinus resinosa, needles, control, tree No. 201

B03559-059	Pinus resinosa, needles, control, tree No. 202
B03559-062	Pinus resinosa, needles, control, tree No. 203
B03559-065	Pinus resinosa, treated, tree No. 281
B03559-068	Pinus resinosa, treated, tree No. 283
B03559-071	Pinus resinosa, treated, tree No. 284
B03559-074	Pinus resinosa, needles, sample No. 217
B03559-076	Pinus resinosa, needles, sample No. 219
B03559-078	Pinus resinosa, needles, sample No. 223
B03559-080	Pinus resinosa, needles, sample No. 240
B03559-082	Pinus resinosa, needles, sample No. 242
B03559-084	Pinus resinosa, needles, sample No. 248
B03559-086	Pinus resinosa, needles, sample No. 204, healthy
B03559-088	Pinus resinosa, 1 in. from base of needles, sample No. 204, healthy
B03559-090	Pinus resinosa, needles, sample No. 205, healthy
B03559-092	Pinus resinosa, needles, sample No. 206, healthy
B03559-094	Pinus resinosa, needles, sample No. 207, poisoned with sodium arsenite
B03559-096	Pinus resinosa, needles, sample No. 208, poisoned with sodium aresnite
B03559-098	Pinus resinosa, one inch from base of needles, sample No. 208, poisoned with sodium arsenite
B03559-100	Pinus resinosa, needles, sample No. 209, poisoned with sodium arsenite
B03559-102	Pinus resinosa, needles, sample No. 210, healthy
B03559-104	Pinus resinosa, needles, sample No. 211, healthy
B03559-106	Pinus resinosa, needles, sample No. 212, healthy
B03559-108	Pinus resinosa, needles, sample No. 213, poisoned with sodium arsenite
B03559-110	Pinus resinosa, needles, sample No. 214, poisoned with sodium arsenite
B03559-112	Pinus resinosa, needles, sample No. 215, poisoned with sodium arsenite
B03559-114	Pinus resinosa, control, tree No. 201
B03559-116	Pinus resinosa, control, tree No. 202
B03559-118	Pinus resinosa, control, tree No. 203
B03559-120	Pinus resinosa, treated, tree No. 281
B03559-122	Pinus resinosa, treated, tree No. 283
B03559-124	Pinus resinosa, treated, tree No. 284
B20000-542	Red pine
B20000-548	Red pine (Pinus resinosa)

80

SCOTCH PINE



B03374-027	Scotch pine (Pinus sylvestris L.) crown position, south side, upper one-third of one-year-old needles, 3 May 1960
B03374-028	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 17 May 1960
B03374-029	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 31 May 1960
B03374-030	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 6 June 1960
B03374-031	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 15 June 1960
B03374-032	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 20 June 1960
B03374-033	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 27 June 1960
B03374-034	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 11 July 1960
B03374-035	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 18 July 1960
B03374-036	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 25 July 1960
B03374-037	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 1 August 1960

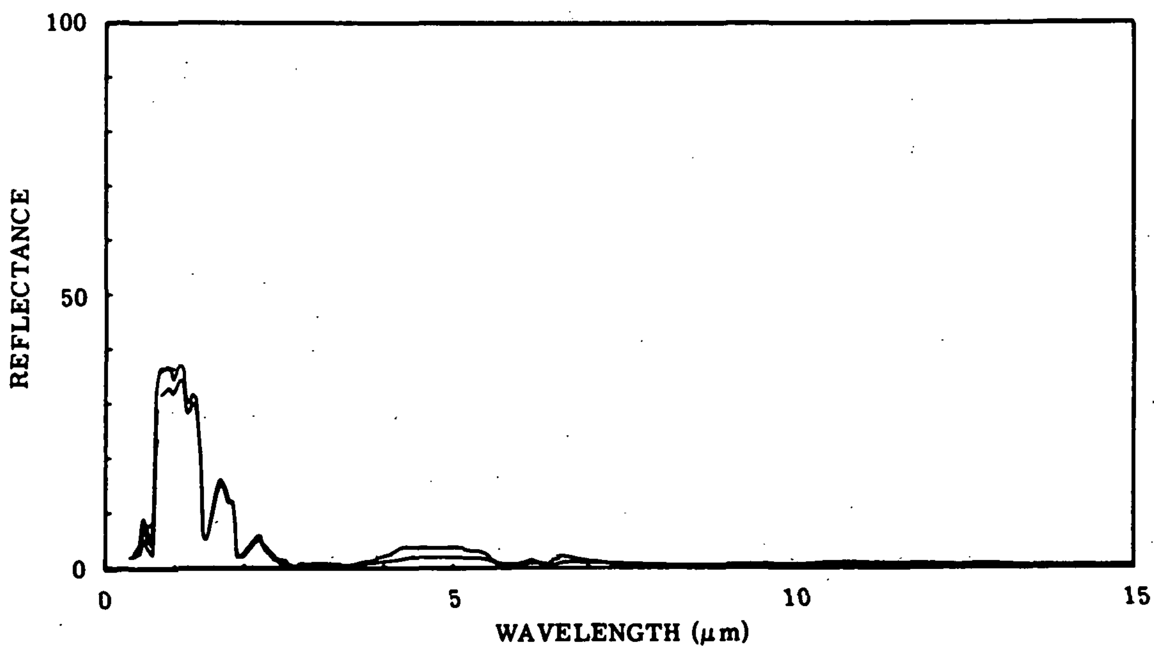
B03374-038	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 8 August 1960
B03374-039	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 22 August 1960
B03374-040	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 29 August 1960
B03374-041	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 6 September 1960
B03374-042	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 12 September 1960
B03374-043	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 19 September 1960
B03374-044	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 27 September 1960
B03374-045	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 4 October 1960
B03374-046	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 11 October 1960
B03374-047	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 18 October 1960
B03374-048	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 25 October 1960
B03374-049	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 1 November 1960
B03374-050	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 10 November 1960
B03374-051	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 16 November 1960
B03374-052	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of ndw needles, 22 November 1960
B03374-436	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 2 February 1961
B03374-437	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 4 March 1961
B03374-438	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 26 April 1961
B03374-439	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 17 May 1961
B03374-440	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 26 May 1961
B03374-441	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 31 May 1961
B03374-442	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 7 June 1961

B03374-443	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 14 June 1961
B03374-444	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 22 June 1961
B03374-445	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 28 June 1961
B03374-446	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 6 July 1961
B03374-447	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 12 July 1961
B03374-448	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 19 July 1961
B03374-449	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 25 July 1961
B03374-450	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of one-year-old needles, 2 August 1961
B03374-451	Scotch pine (Pinus sylvestris L.), crown position, south side,upper one-third of one-year-old needles, 11 August 1961
B03374-452	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 22 June 1961
B03374-453	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 28 June 1961
B03374-454	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 6 July 1961
B03374-455	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 12 July 1961
B03374-456	Sctotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 19 July 1961
B03374-457	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 25 July 1961
B03374-458	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 2 August 1961
B03374-459	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 11 August 1961
B03374-460	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 16 August 1961
B03374-461	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 24 August 1961
B03374-462	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 29 August 1961
B03374-463	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 6 September 1961
B03374-464	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 13 September 1961

B03374-465	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 19 September 1961
B03374-466	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 25 September 1961
B03374-467	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 3 October 1961
B03374-468	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 10 October 1961
B03374-469	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 17 October 1961
B03374-470	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 25 October 1961
B03374-471	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 3 November 1961
B03374-472	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 8 November 1961
B03374-473	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 17 November 1961
B03374-474	Scotch pine (Pinus sylvestris L.), crown position, south side, upper one-third of new needles, 7 December 1961
B20000-517	Scotch pine, twig and needles
B20000-541	Scotch pine
B20000-547	Scotch pine (Pinus sylvestris)

81

SPRUCE



B03355-018	Spruce leaves (Summer, 1951)
B03355-024	Spruce tree (16-31 May 1952)
B03355-030	Spruce tree (1-15 June 1952)
B03355-036	Spruce tree (16-30 June 1952)
B03333-015	Black spruce
B20000-545	Blue spruce needles
B20000-546	Red spruce needles
B20000-553	Blue spruce
B20000-554	Red spruce
B04696-043	Black spruce (Picea mariana), mosaic of needles

4.2. SINGLE PLOTS

4.2.1. LABORATORY DATA

Data contained in this Section were obtained from the following documents:

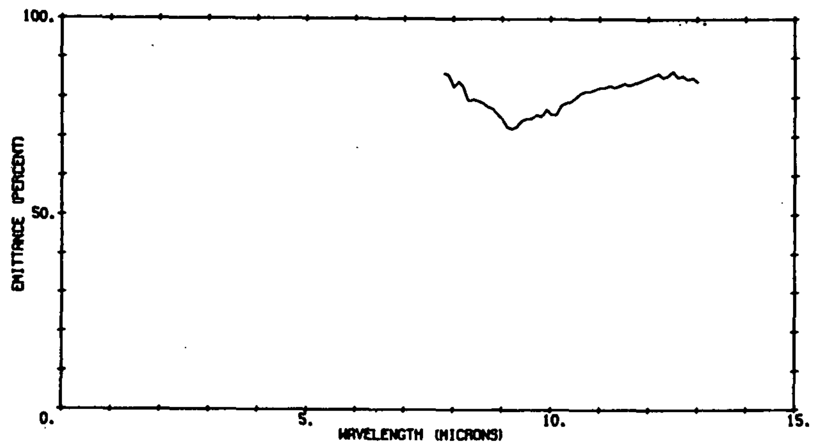
A0***
B00829
B00830
B01049
B01176
B01339
B01352
B01367
B01368
B01761
B01818
B01948
B02131
B02418
B03258
B03333
B03355
B03995
B04424
B04696
B04802
B04803
B04804
B04979
B05272
B07139
B13946
B14004
B20000

IGNEOUS ROCKS

Acidic (greater than 65% SiO_2) Silicate Rocks

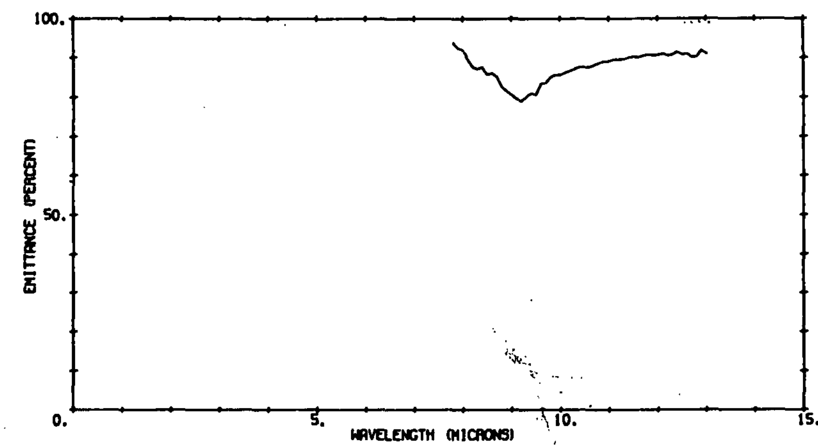
B02131 006

OBSIDIAN, THE GLASSY EQUIVALENT OF GRANITE.



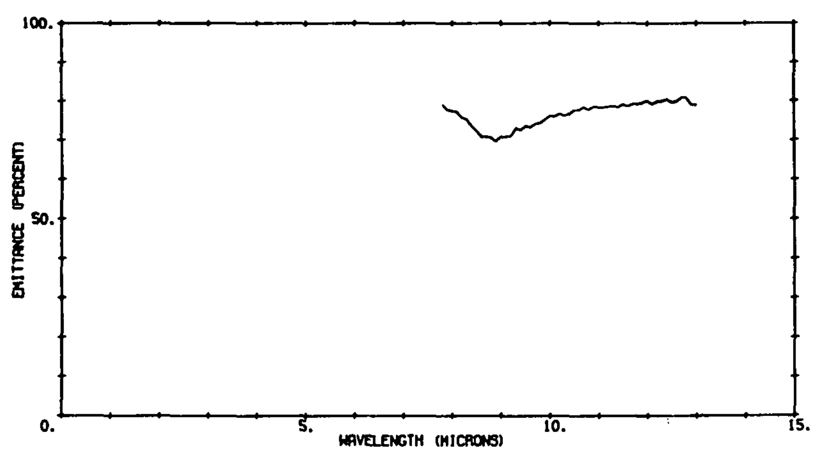
B02131 007

FROTHY PUMICE.



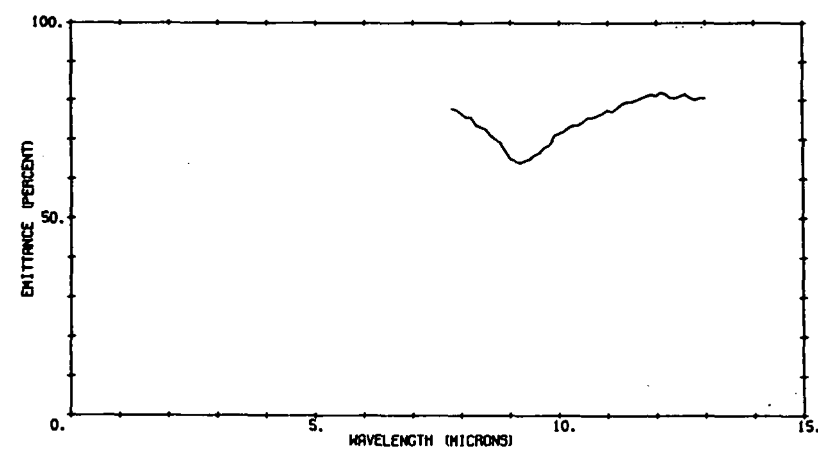
B02131 008

WELDED TUFF.



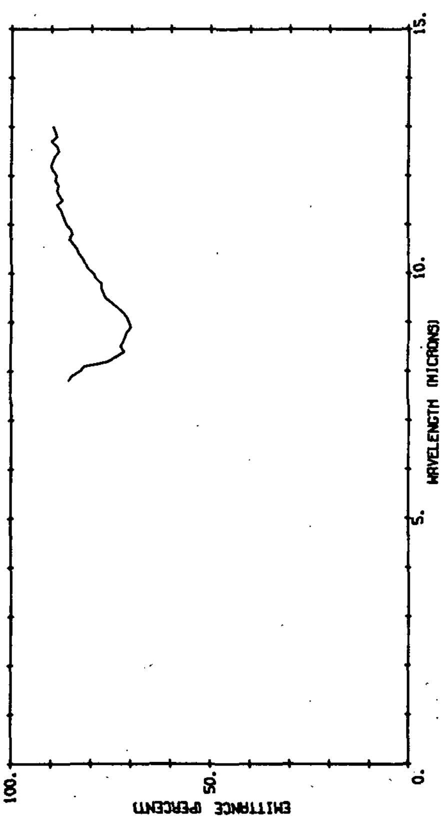
B02131 009

TEKTITE.



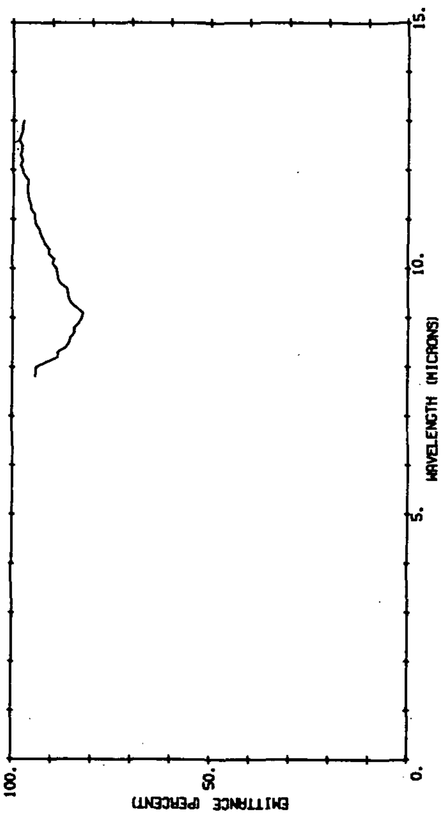
B02131 010

QUARTZ MONZONITE PORPHYRY (SRI 3582).



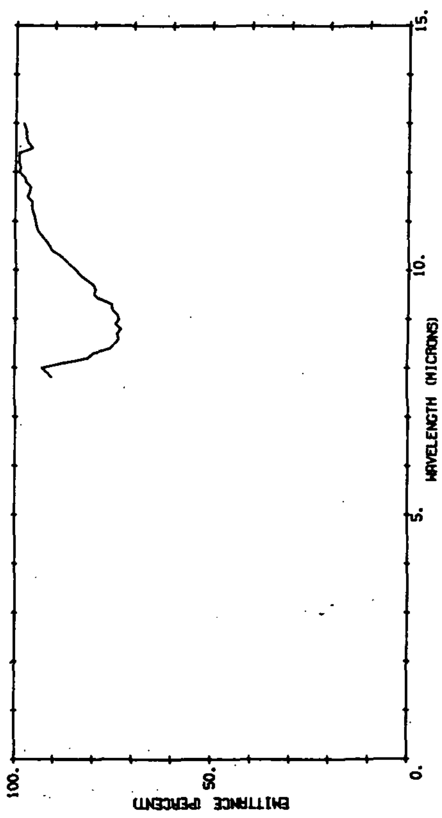
B02131 011

DACITE (USNM 82).



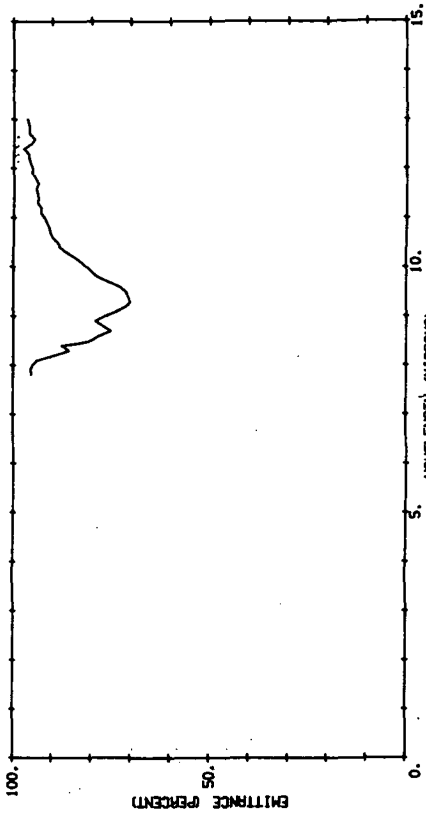
B02131 012

GRANITE (USNM 158).



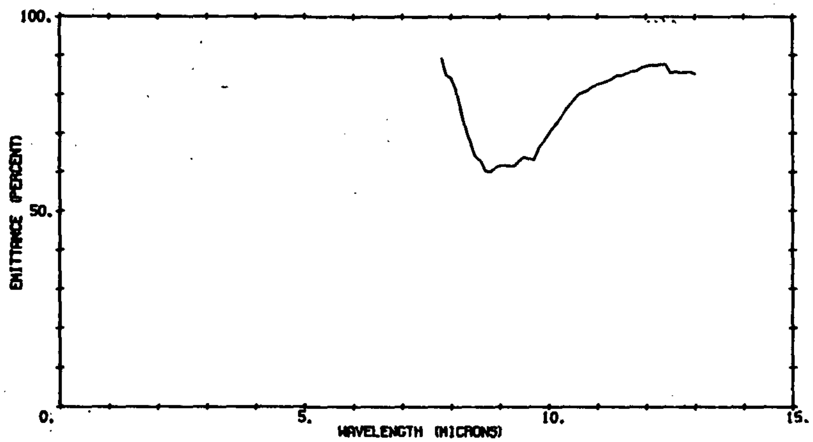
B02131 013

GRAPHIC GRANITE (USNM 377) CONTAINING QUARTZ AND FELDSPAR.



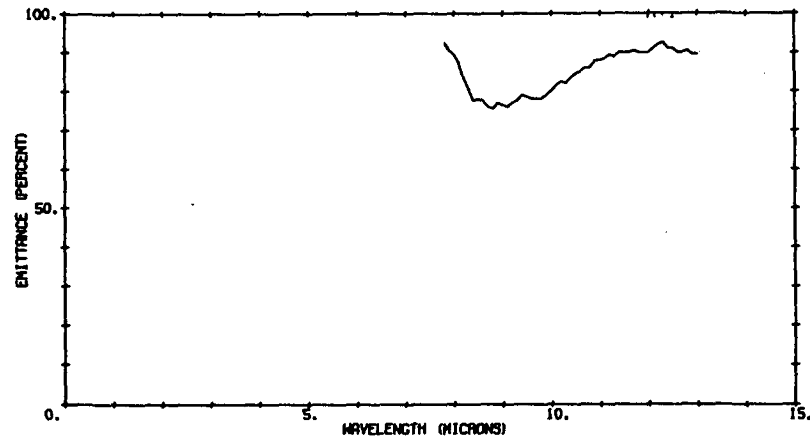
B02131 014

APLITE VEIN (A FINE-GRAINED VEINLET) FROM SHOAL TEST SITE.



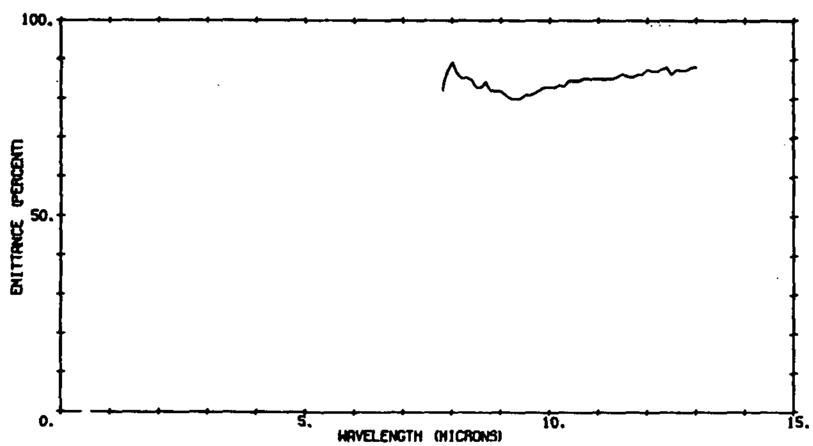
B02131 015

.PYROXENE APLITE (USNM 1924).



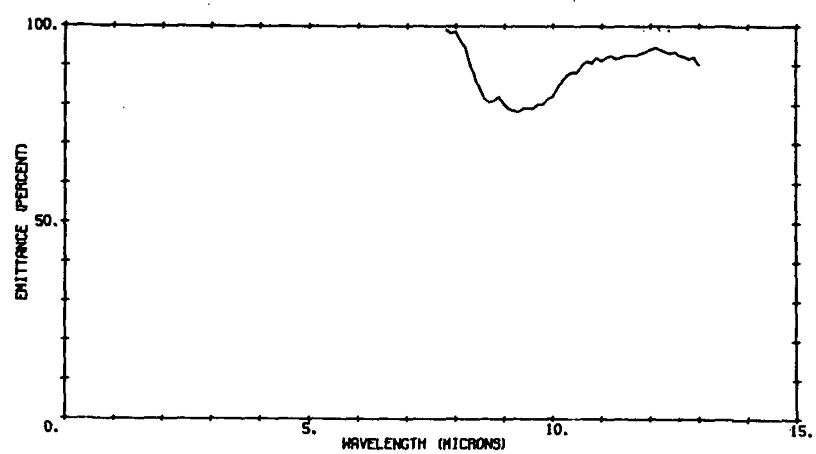
B02131 016

PHYOLITE PUMICE (USNM 59).



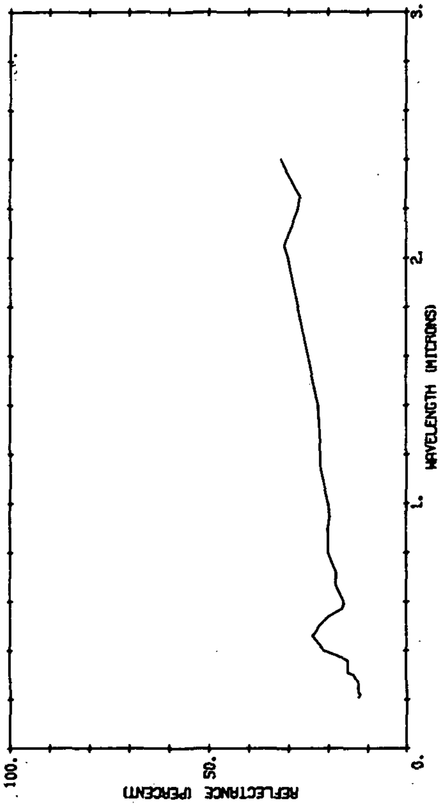
B02131 017

GRANITE GNEISS (USNM 605).



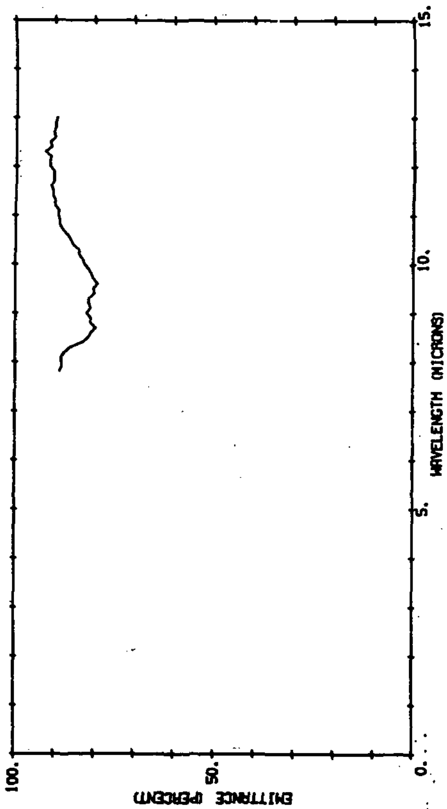
B14004 095

POTASH GRANITE



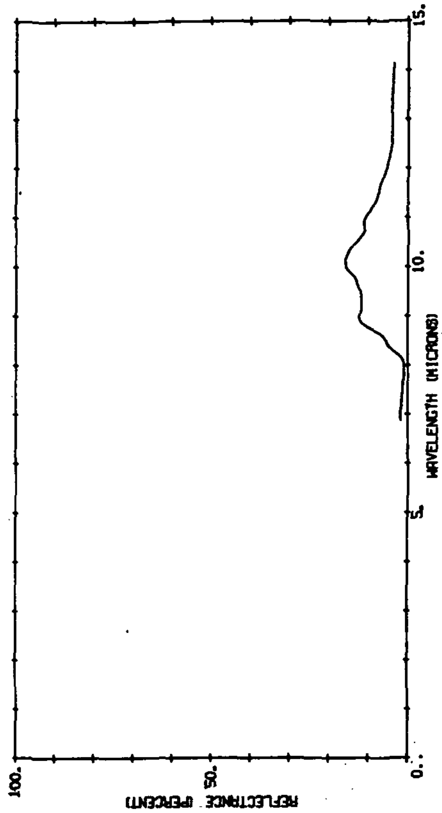
B02131 018

TRACHYTE (USNM 70).



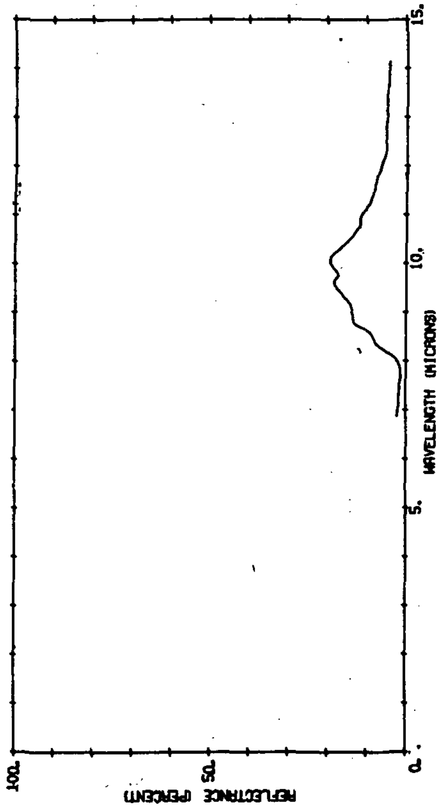
B07139 021

PRECAMBRIAN MIGMATITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



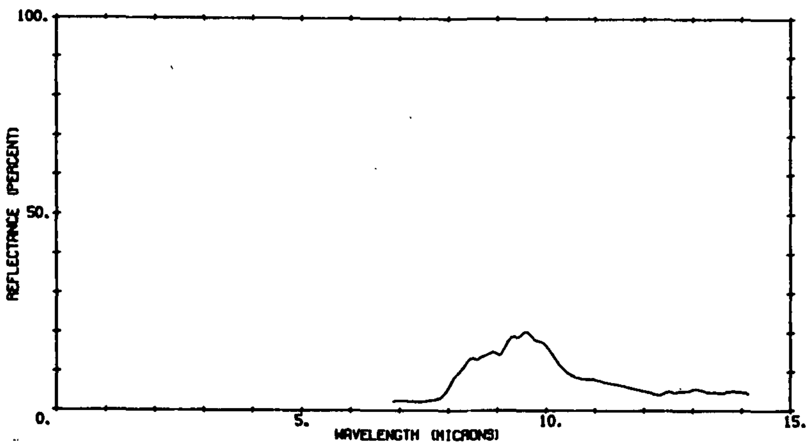
B07139 020

PRECAMBRIAN MIGMATITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



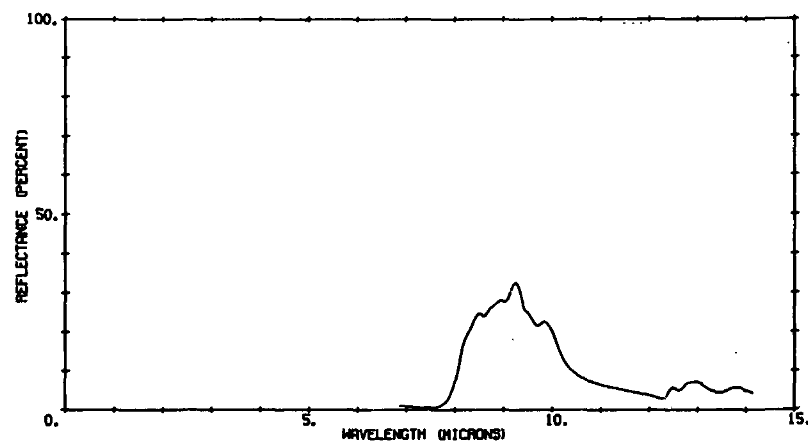
B07139 016

PRECAMBRIAN ADAMELLITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



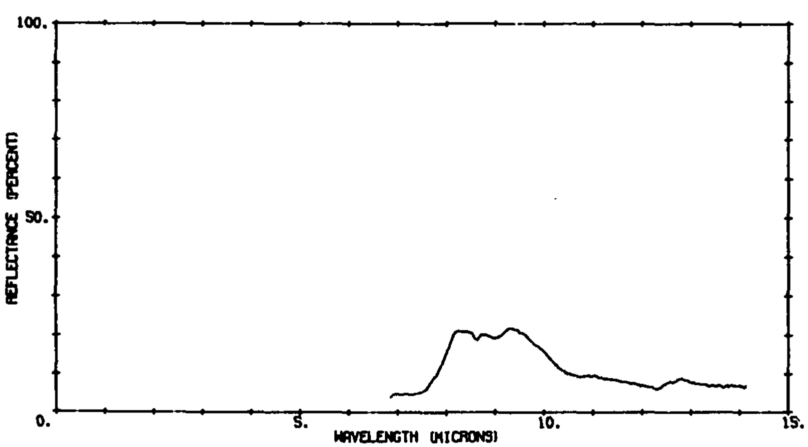
B07139 017

PRECAMBRIAN ADAMELLITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



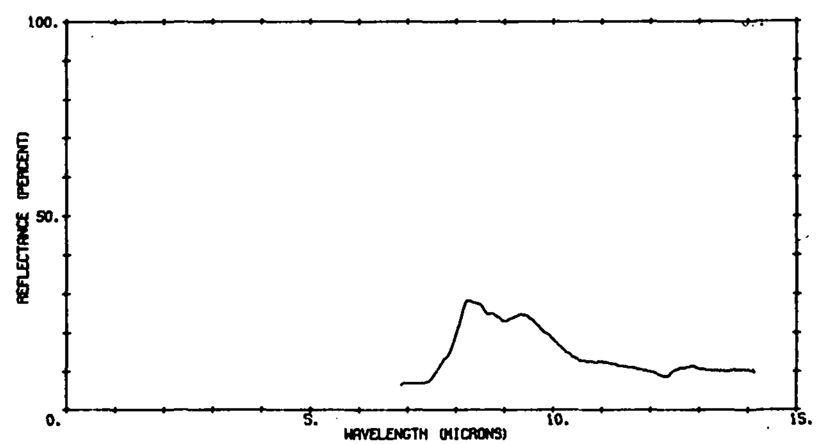
B07139 061

PRECAMBRIAN ADAMELLITE, WEATHERED SURFACE.
VIEWING ANGLE = 45 DEG.



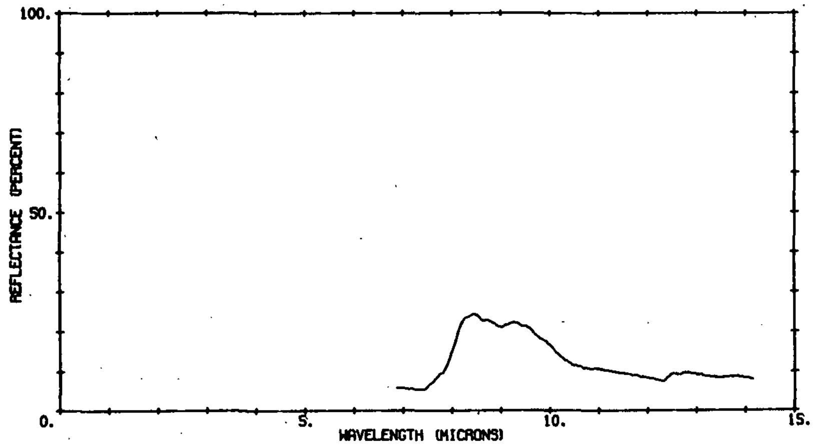
B07139 062

PRECAMBRIAN ADAMELLITE, WEATHERED SURFACE.
VIEWING ANGLE = 60 DEG.



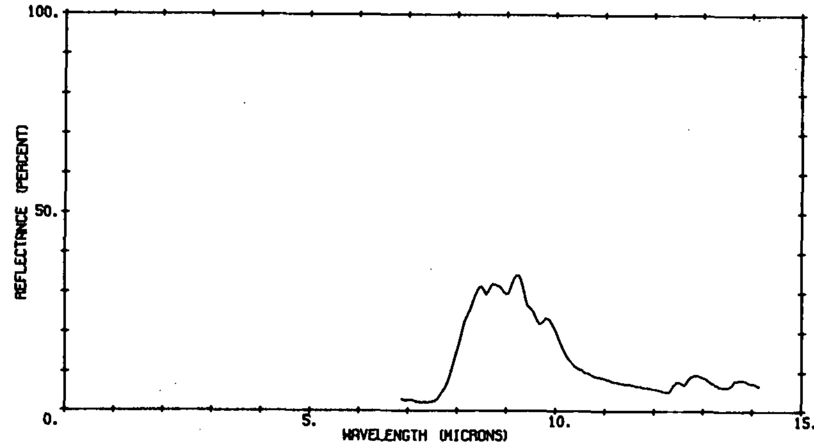
B07139 063

PRECAMBRIAN ADAMELLITE, WEATHERED SURFACE.
VIEWING ANGLE = 75 DEG.



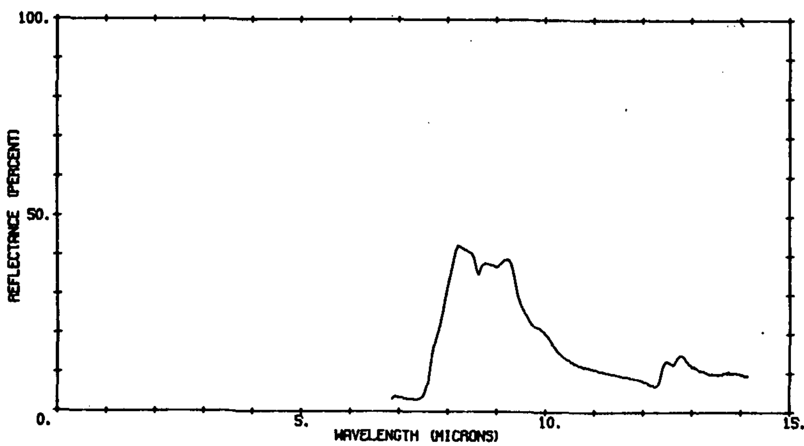
B07139 064

PRECAMBRIAN ADAMELLITE, FRESH SURFACE.
VIEWING ANGLE = 45 DEG.



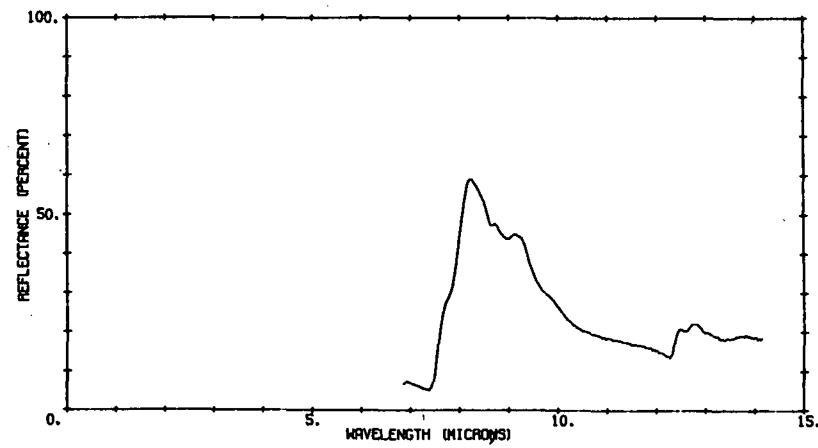
B07139 065

PRECAMBRIAN ADAMELLITE, FRESH SURFACE.
VIEWING ANGLE = 60 DEG.



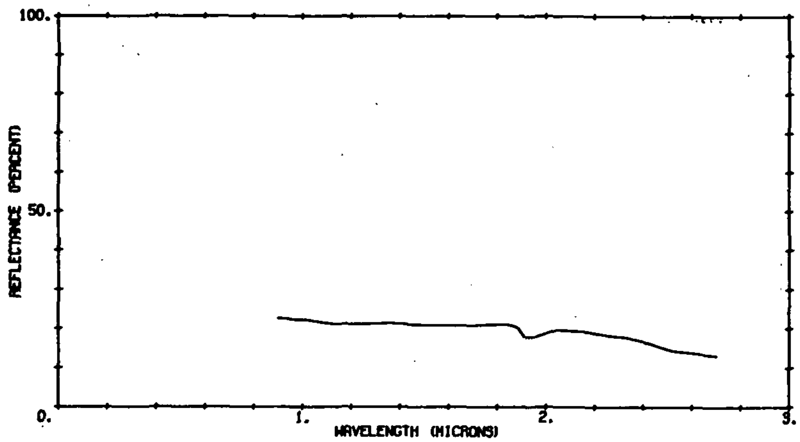
B07139 066

PRECAMBRIAN ADAMELLITE, FRESH SURFACE.
VIEWING ANGLE = 75 DEG.



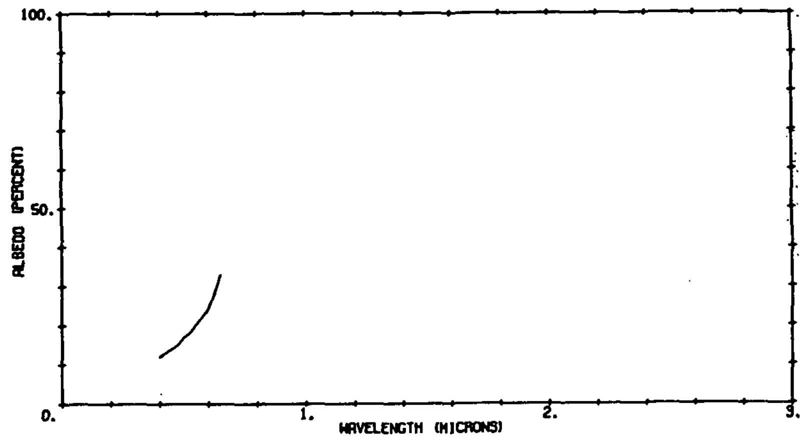
R00266 001

FELSITE, VEINED BY QUARTZ.



B03258 006

GRANITE PEDIMENT



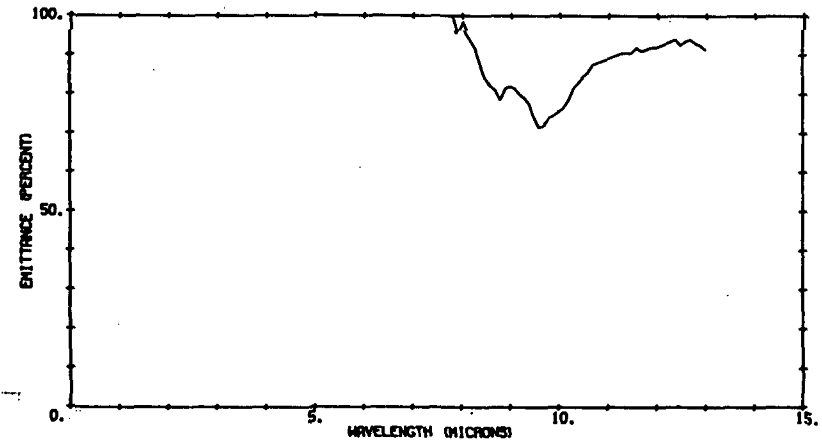
102

IGNEOUS ROCKS

Intermediate (53 to 65% SiO_2) Silicate Rocks

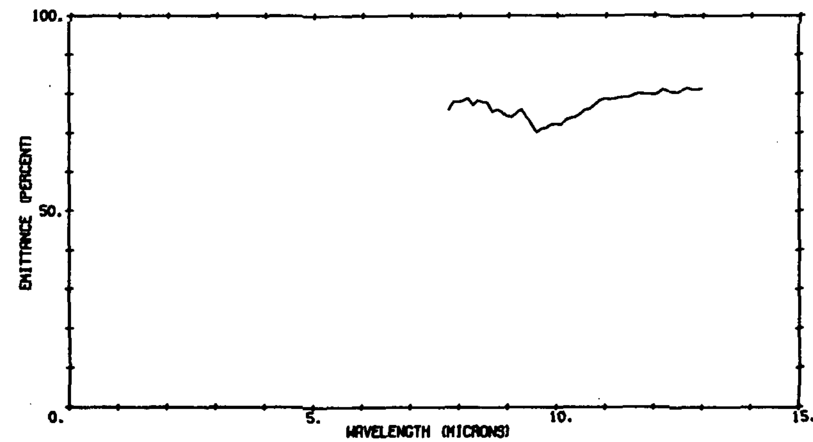
B02131 019

SYENITE (USNM 631).



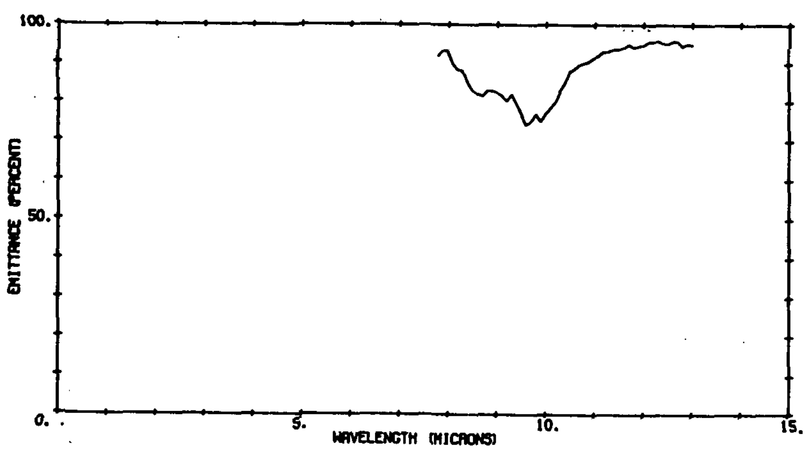
B02131 020

ANDESITE (MONZONITE PORPHYRY) (USNM 1331).



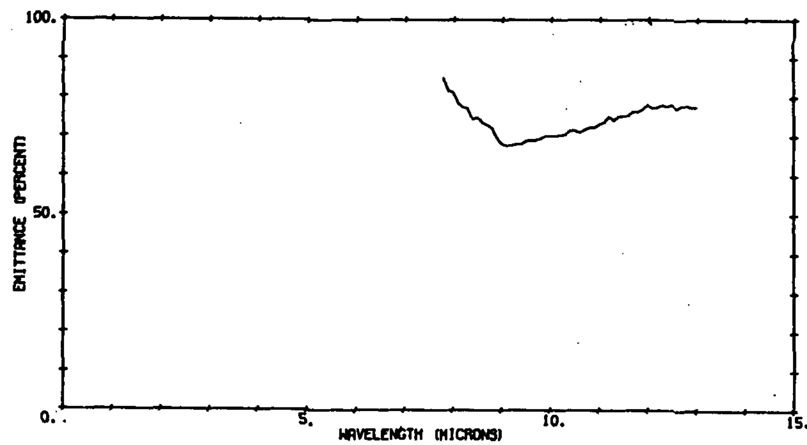
B02131 021

NEPHELINE SYENITE (USNM 77).



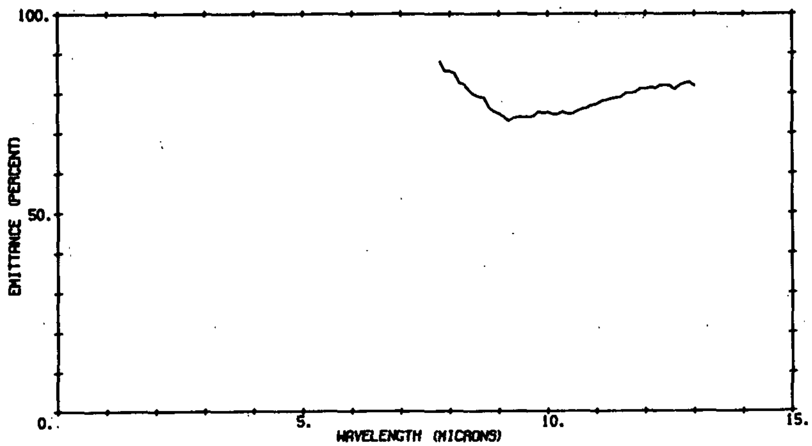
B02131 022

QUARTZ BASALT (USNM 101).



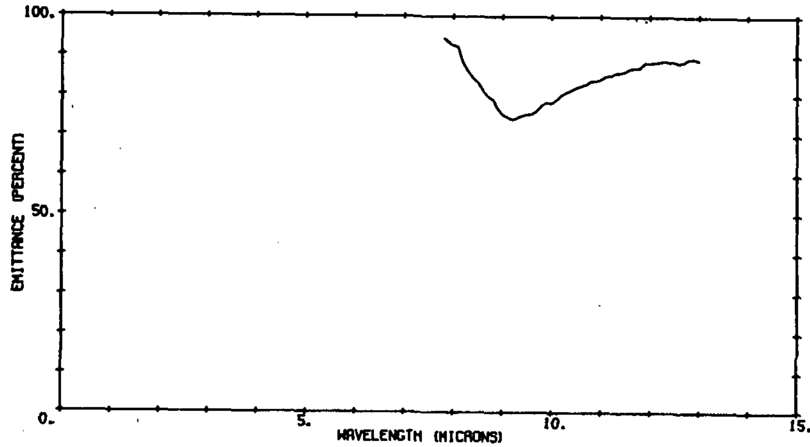
B02131 023

HYPERSTHENE ANDESITE (USNM 86).



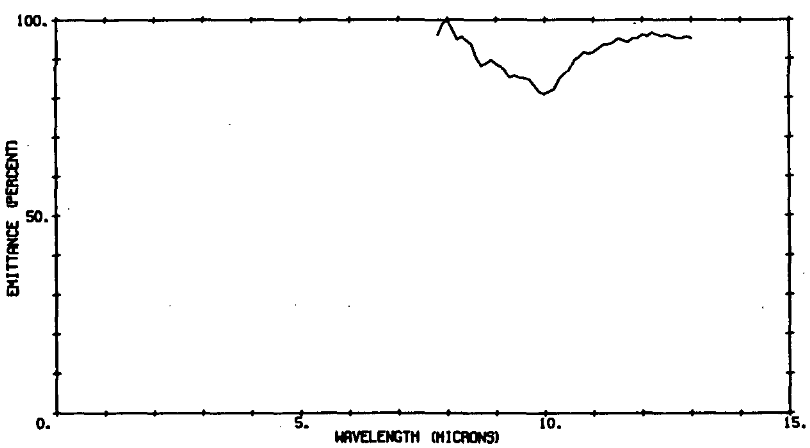
B02131 024

HYPERSTHENE ANDESITE (USNM 371).



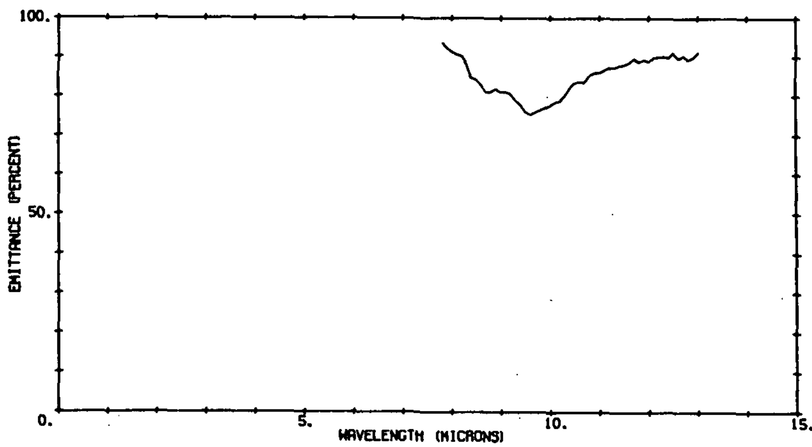
B02131 025

QUARTZ DIORITE (USNM 758).



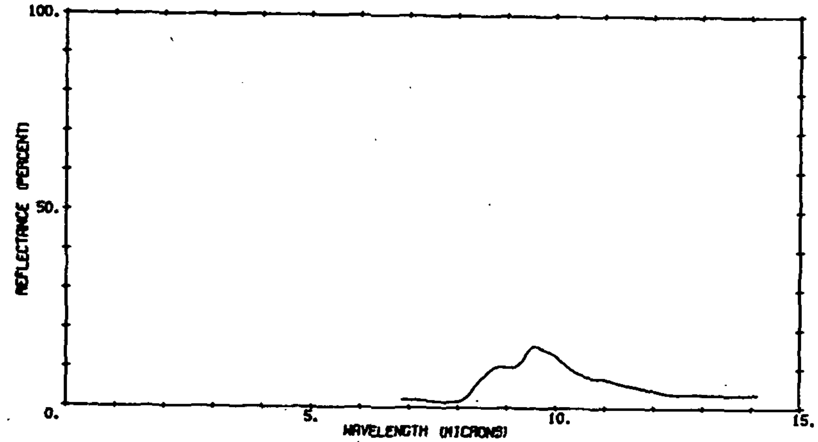
B02131 026

AUGITE DIORITE (USNM 529).



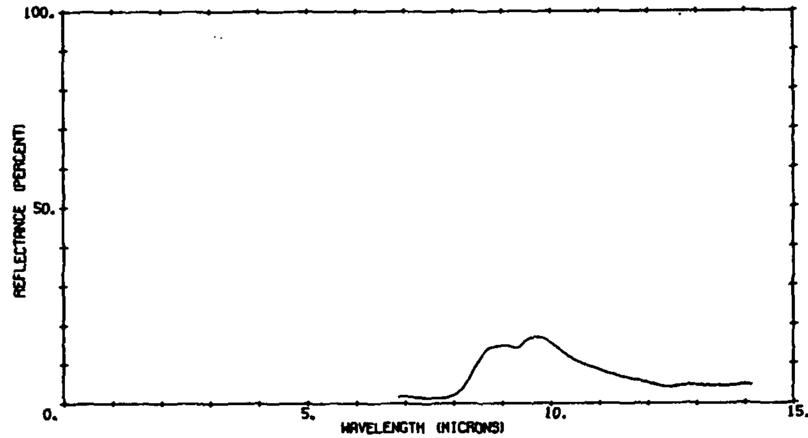
B07139 003

SQUIRREL GULCH LATITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



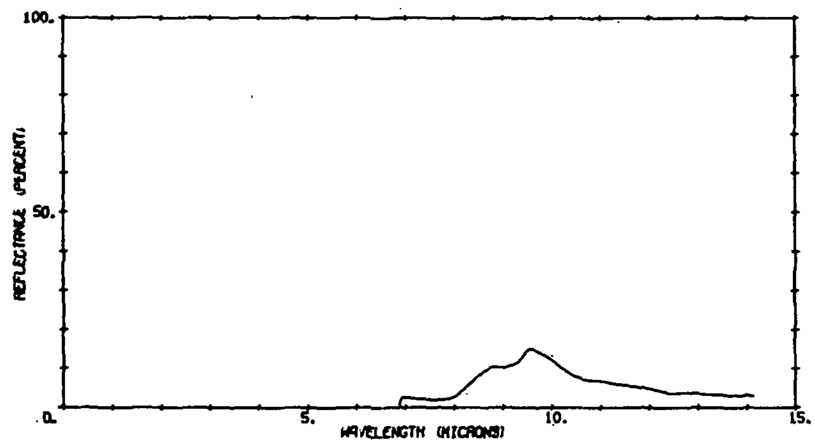
B07139 004

SQUIRREL GULCH LATITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



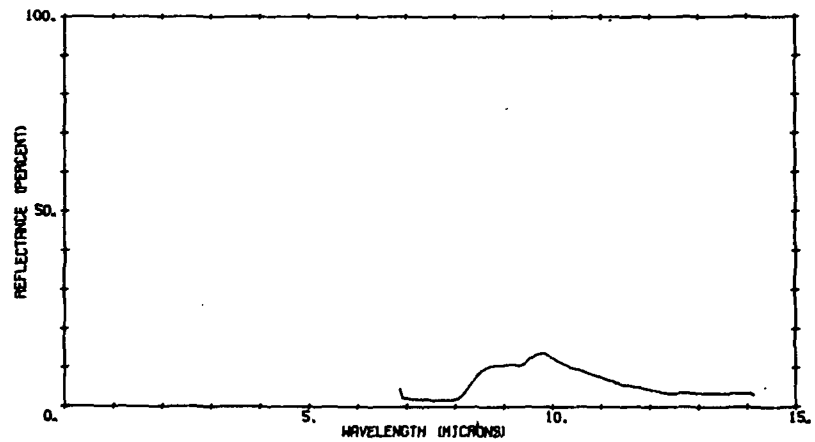
B07139 024

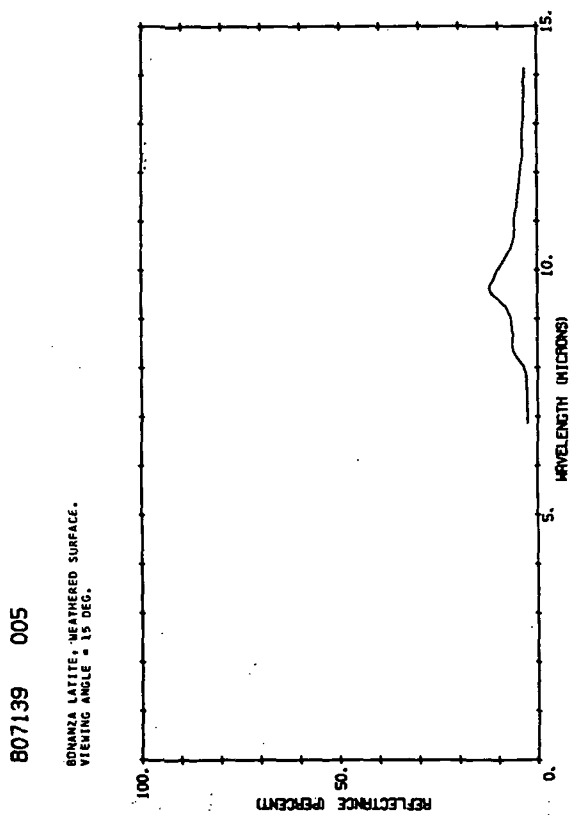
SQUIRREL GULCH LATITE, WEATHERED.
VIEWING ANGLE = 15 DEG.

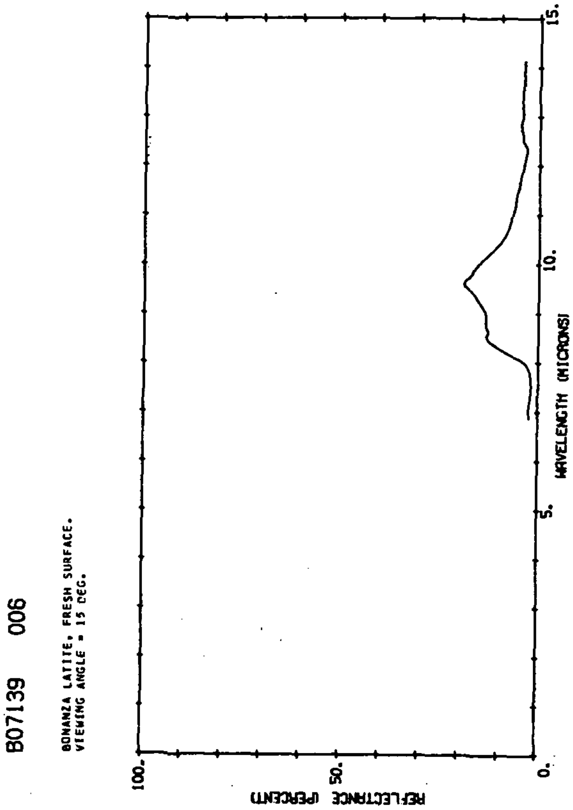


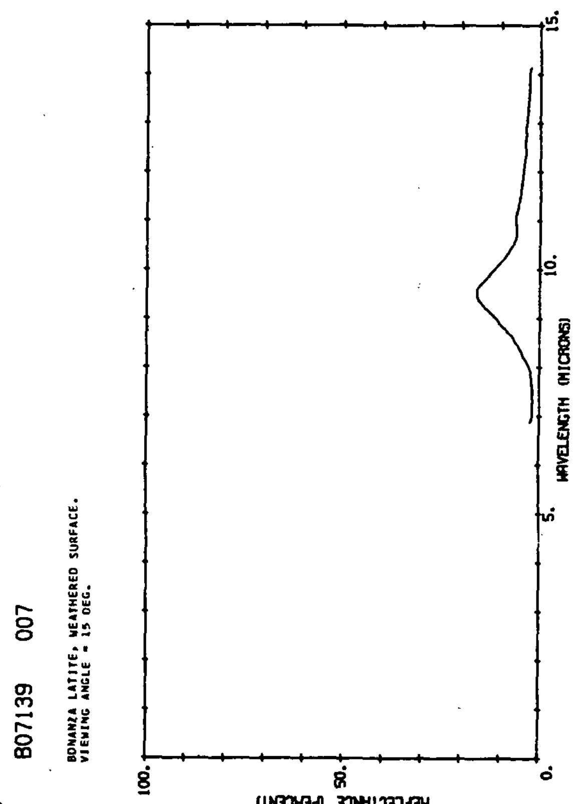
B07139 025

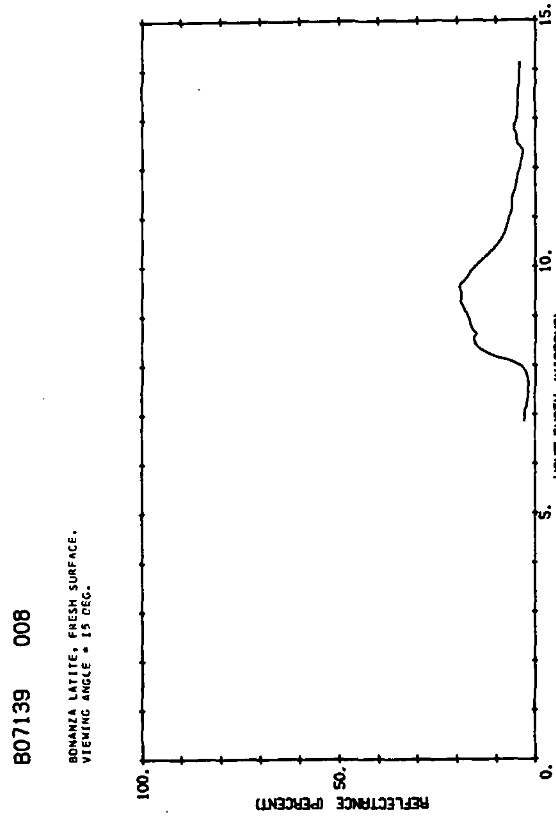
SQUIRREL GULCH LATITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.




B07139 005
BONANZA LATITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
5.
10.
15.

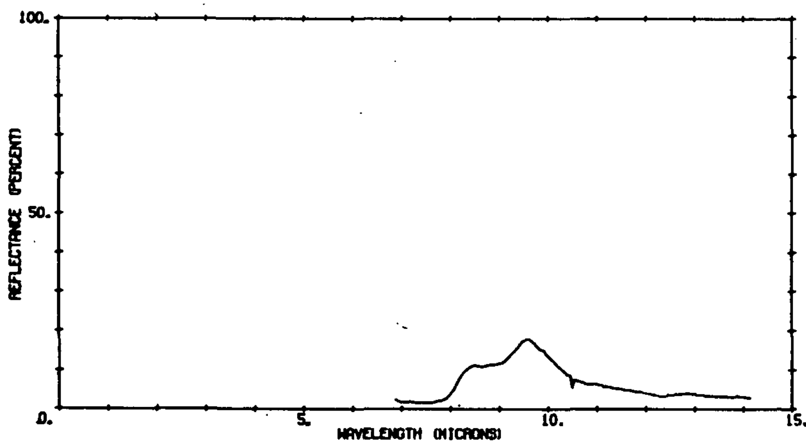

B07139 006
BONANZA LATITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
5.
10.
15.


B07139 007
BONANZA LATITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
5.
10.
15.


B07139 008
BONANZA LATITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
5.
10.
15.

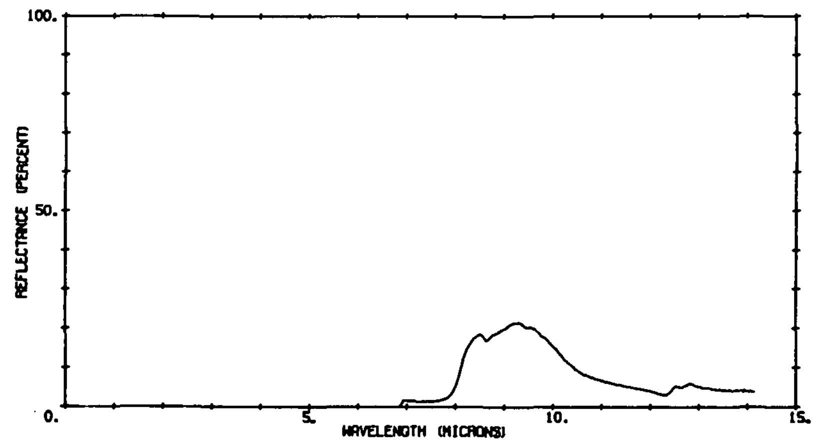
B07139 026

BONANZA LATITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



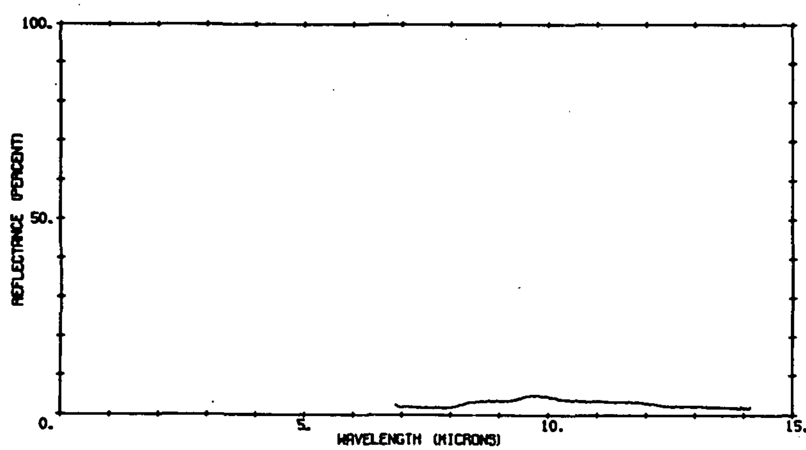
B07139 027

BONANZA LATITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



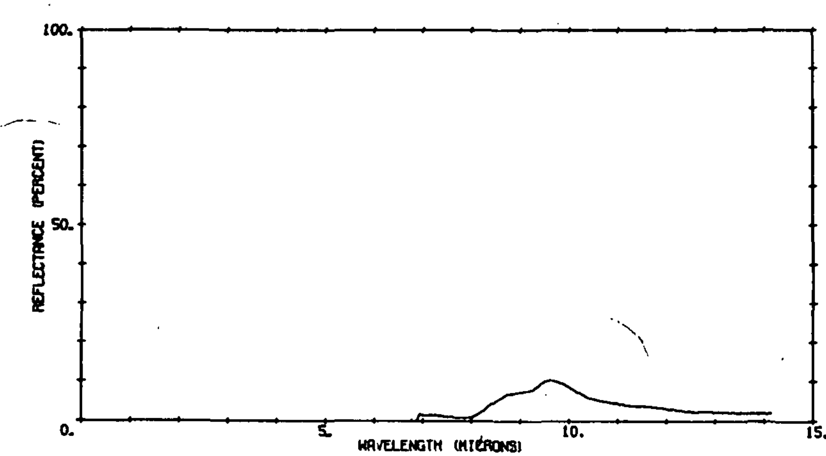
B07139 028

BONANZA LATITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



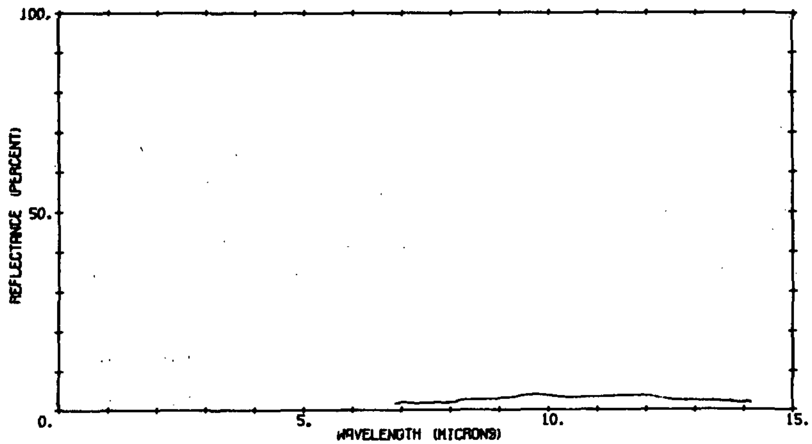
B07139 029

BONANZA LATITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



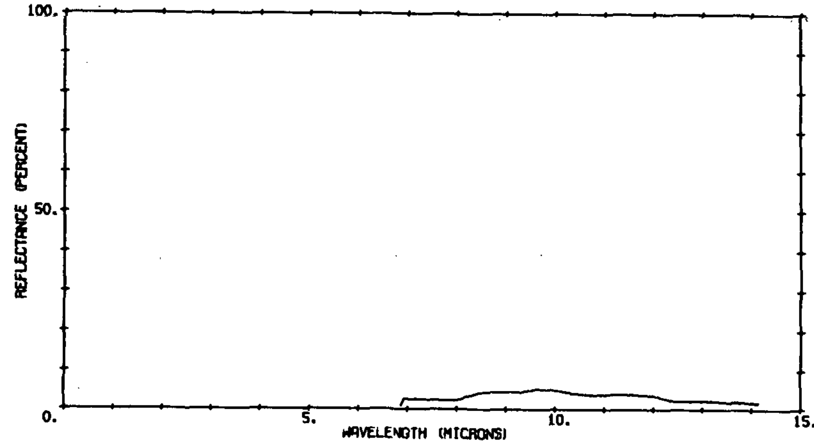
B07139 040

RAWLEY ANDESITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



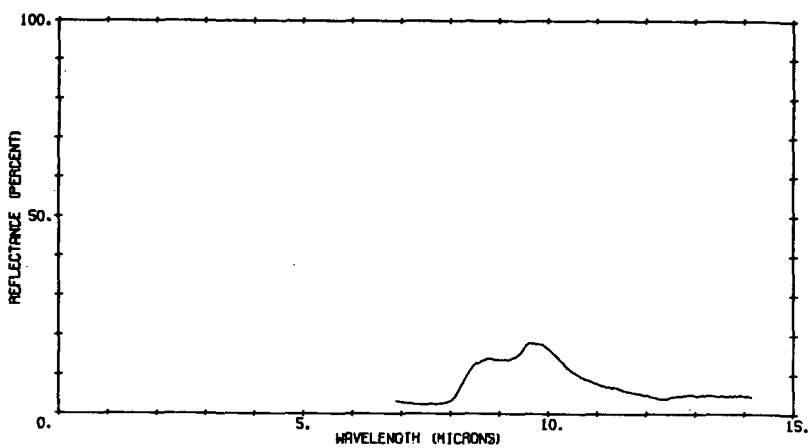
B07139 041

BONANZA LATITE
VIEWING ANGLE = 15 DEG.



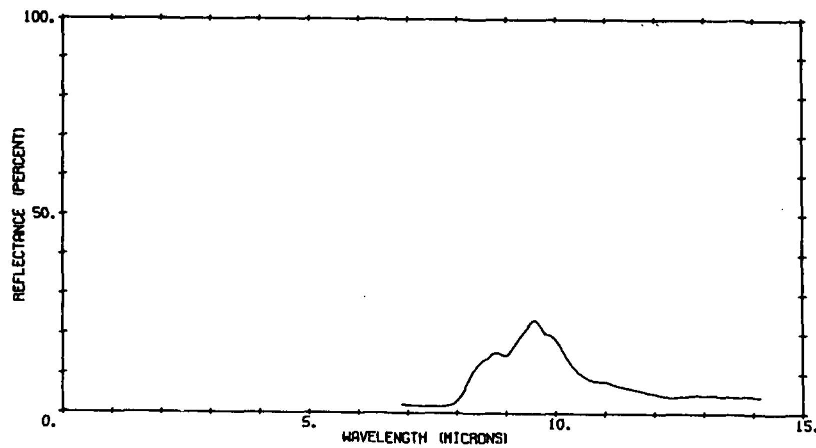
B07139 042

BONANZA LATITE
VIEWING ANGLE = 15 DEG.



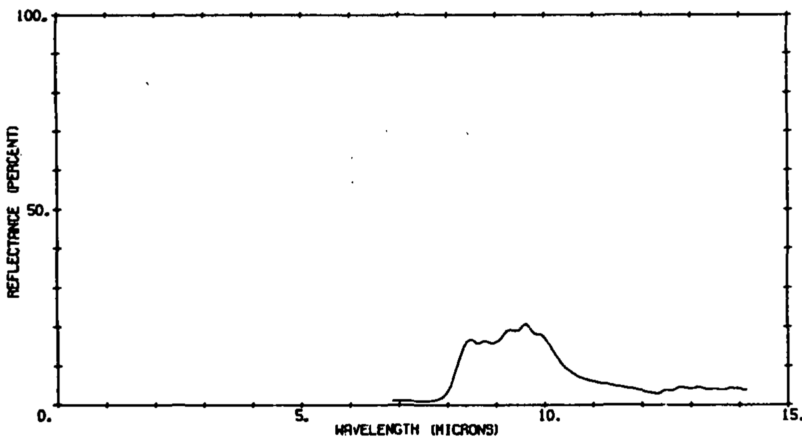
B07139 011

EAGLE GULCH LATITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



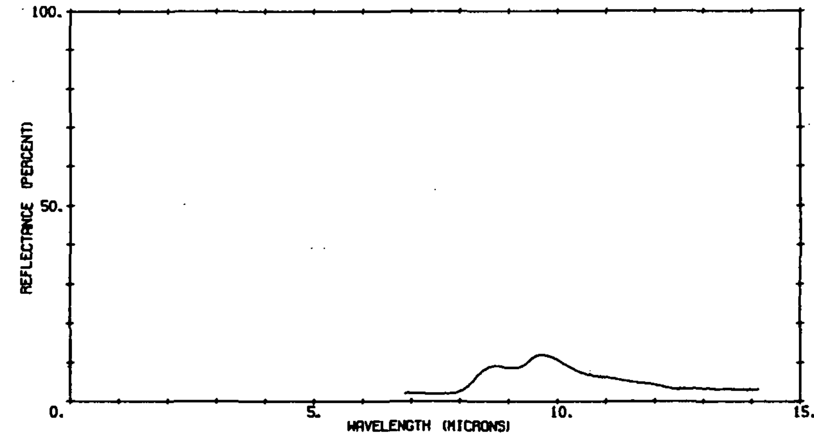
B07139 012

EAGLE GULCH LATITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



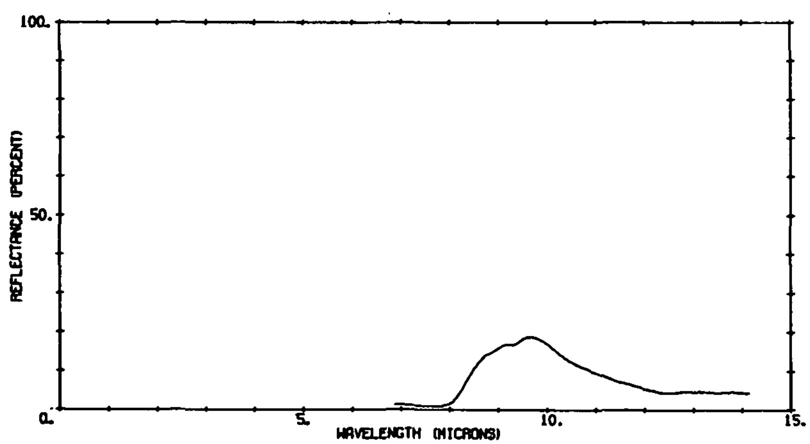
B07139 022

BIOTITE ANDESITE FLOW, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



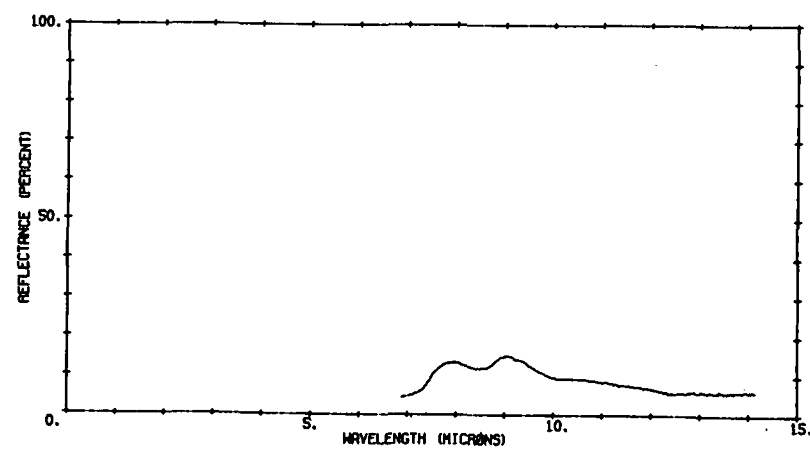
B07139 023

BIOTITE ANDESITE FLOW, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



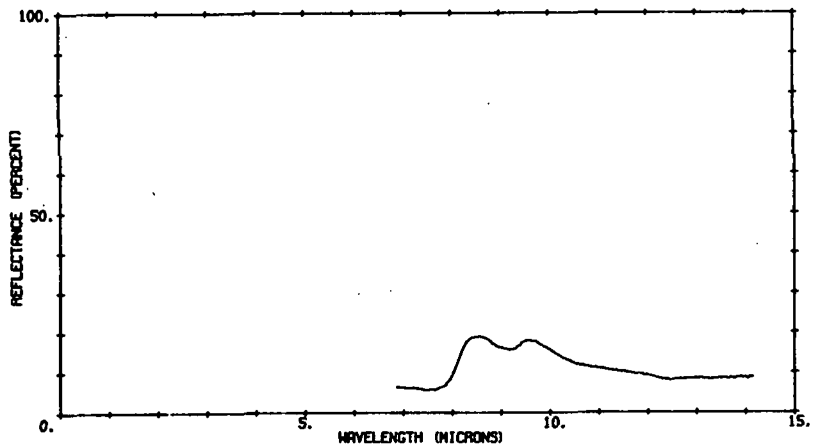
B07139 049

BIOTITE ANDESITE FLOW, WEATHERED SURFACE.
VIEWING ANGLE = 45 DEG



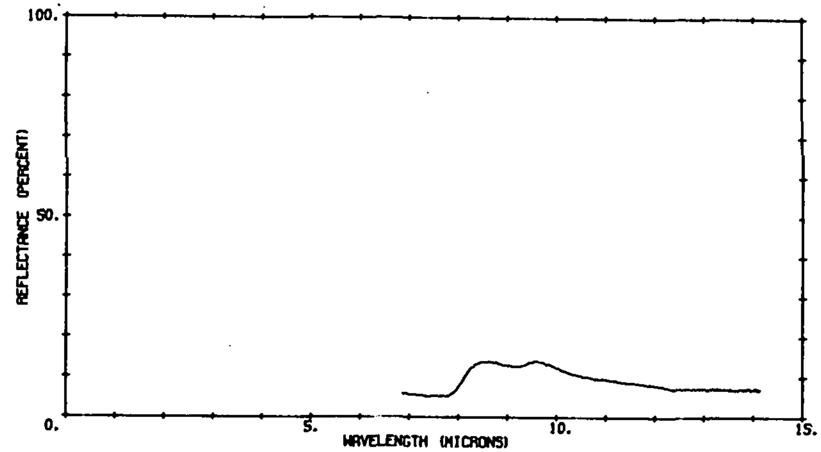
B07139 050

BIOTITE ANDESITE FLOW, WEATHERED SURFACE.
VIEWING ANGLE = 60 DEG.



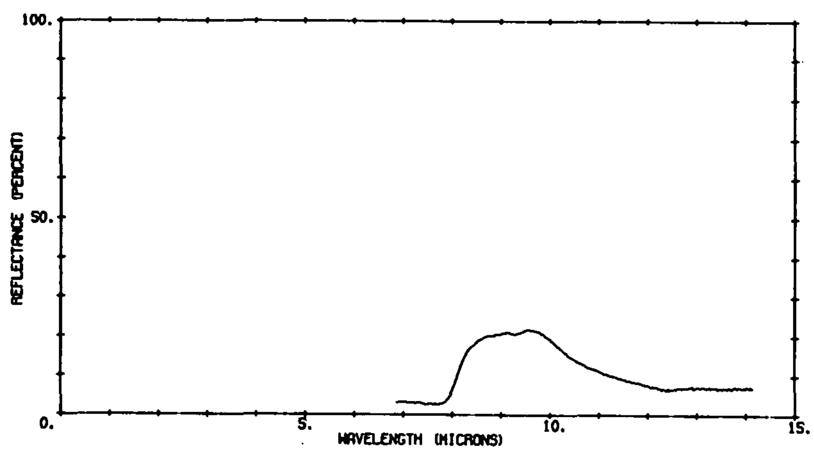
B07139 051

BIOTITE ANDESITE FLOW, WEATHERED SURFACE.
VIEWING ANGLE = 75 DEG.



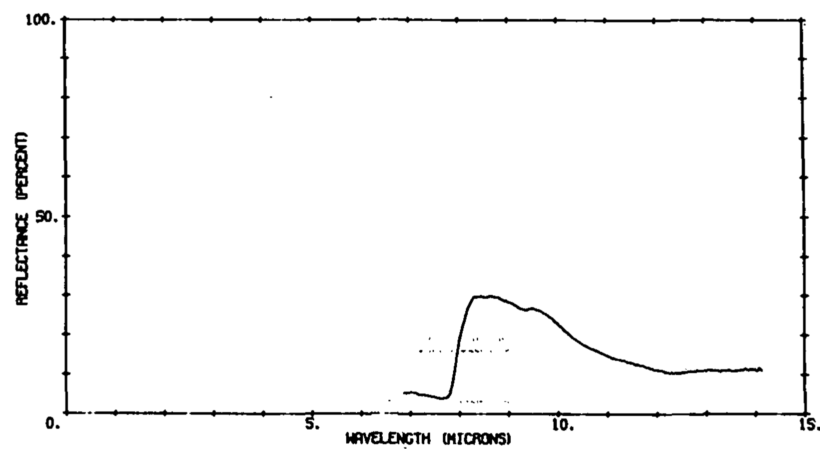
B07139 052

BIOTITE ANDESITE FLOW, FRESH SURFACE.
VIEWING ANGLE = 45 DEG.



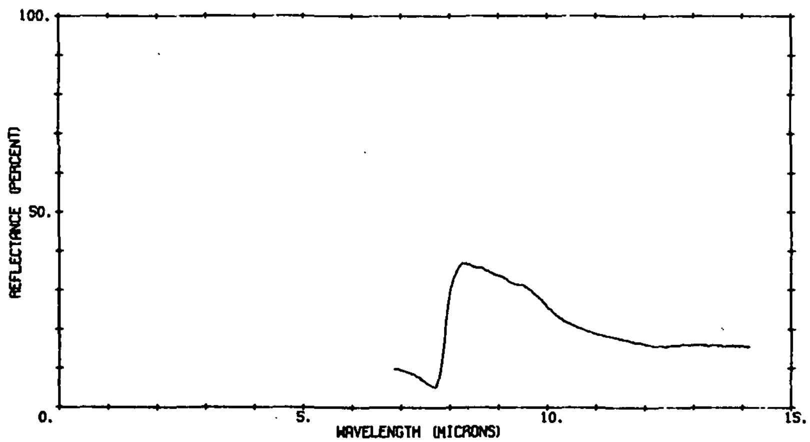
B07139 053

BIOTITE ANDESITE FLOW, FRESH SURFACE.
VIEWING ANGLE = 60 DEG.



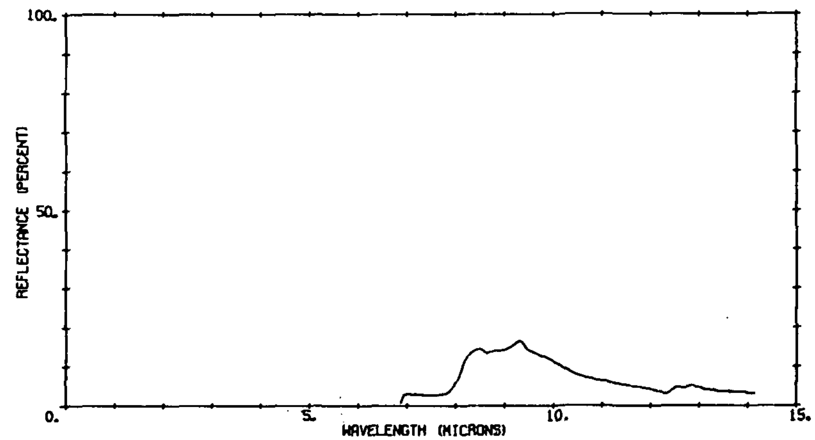
B07139 054

BIOTITE ANDESITE FLOW, FRESH SURFACE.
VIEWING ANGLE = 75 DEG.



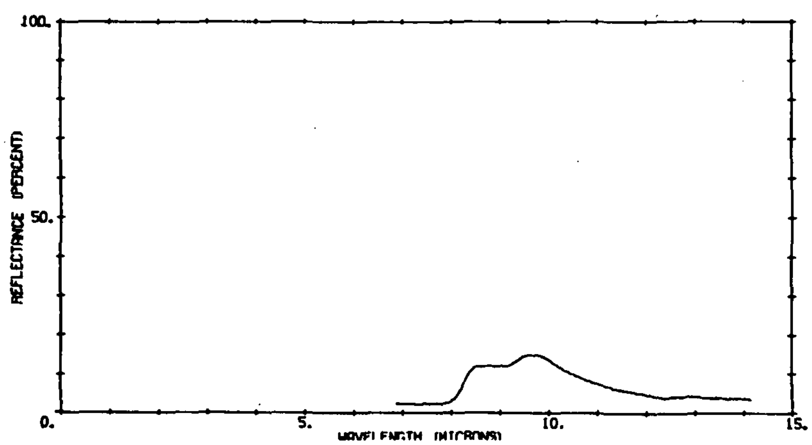
B07139 030

RAWLEY ANDESITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



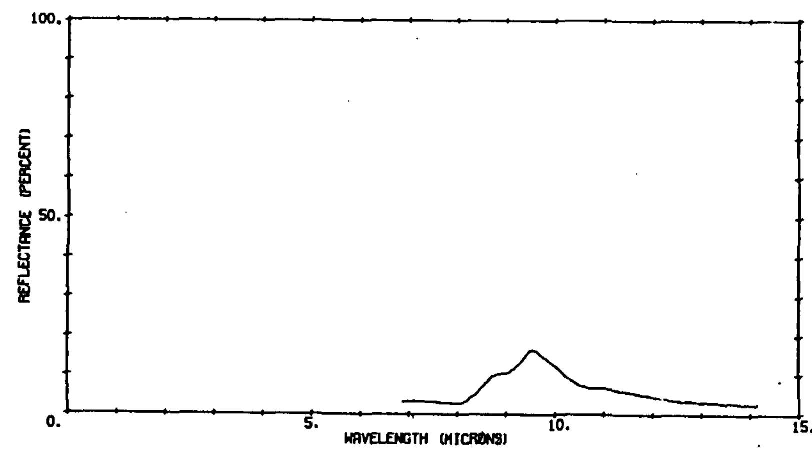
B07139 031

RAWLEY ANDESITE, ANDESITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



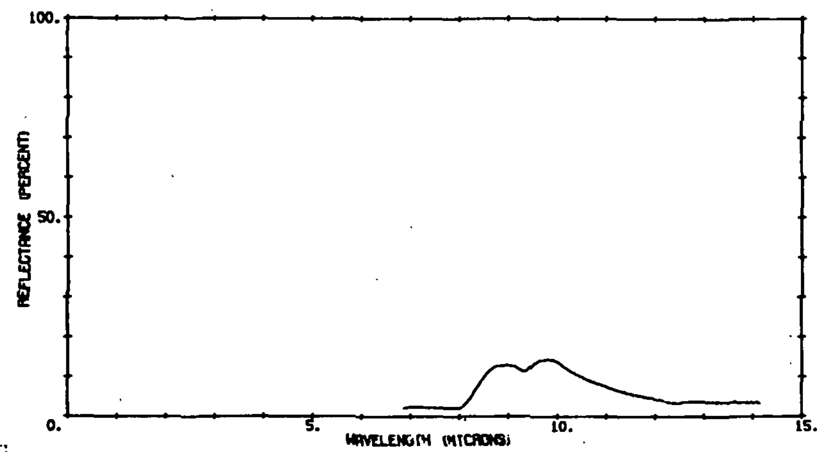
B07139 032

RAWLEY ANDESITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



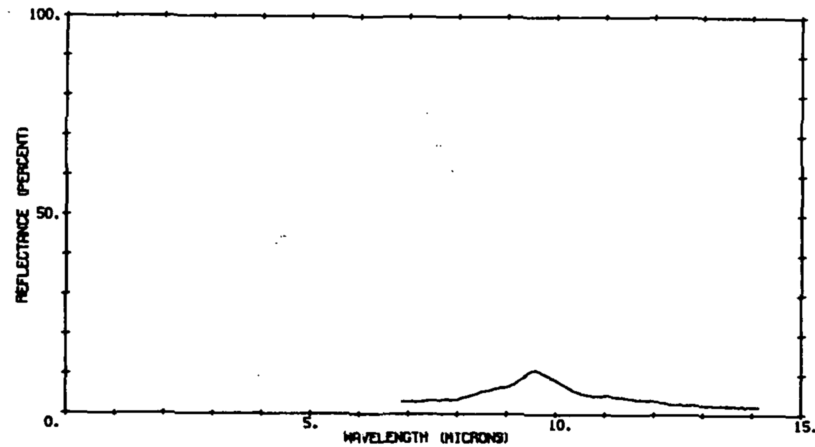
B07139 033

RAWLEY ANDESITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



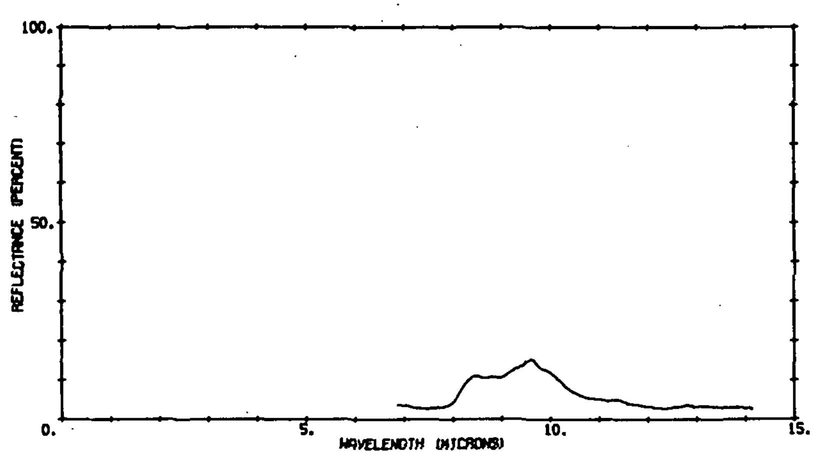
B07139 036

RAWLEY ANDESITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



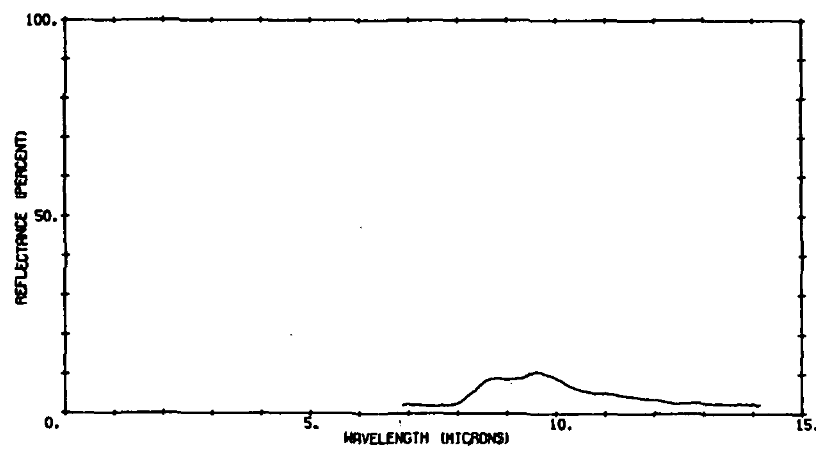
B07139 037

RAWLEY ANDESITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



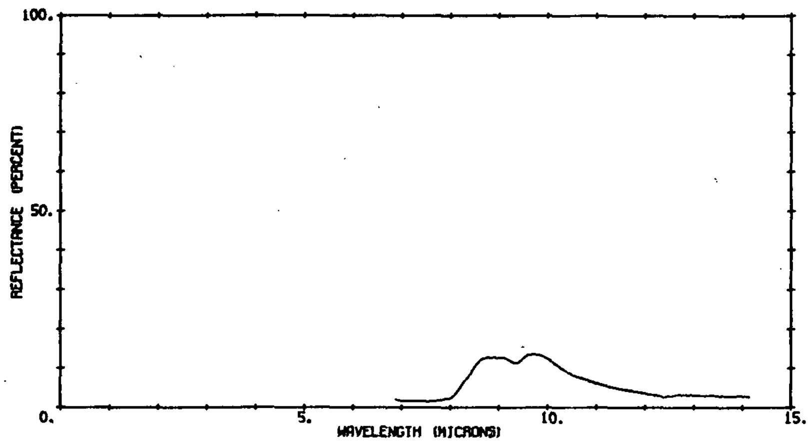
B07139 038

RAWLEY ANDESITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



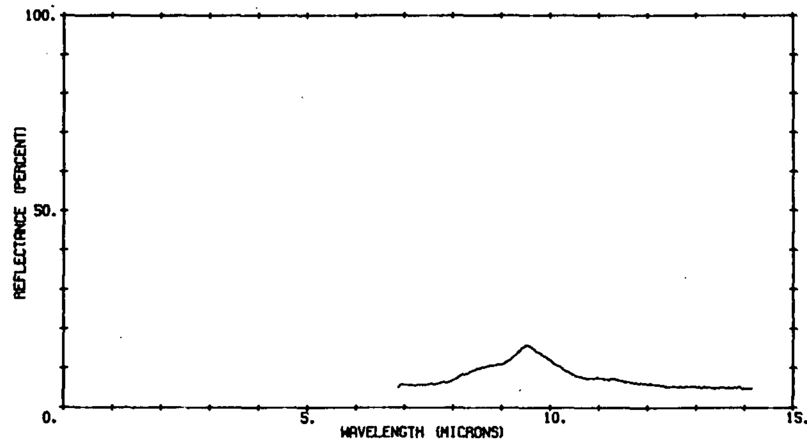
B07139 039

RAWLEY ANDESITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



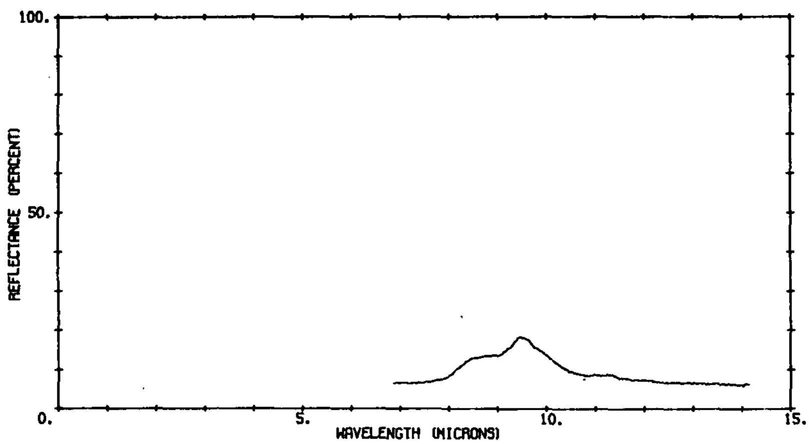
B07139 067

RAWLEY ANDESITE, WEATHERED SURFACE.
VIEWING ANGLE = 45 DEG.



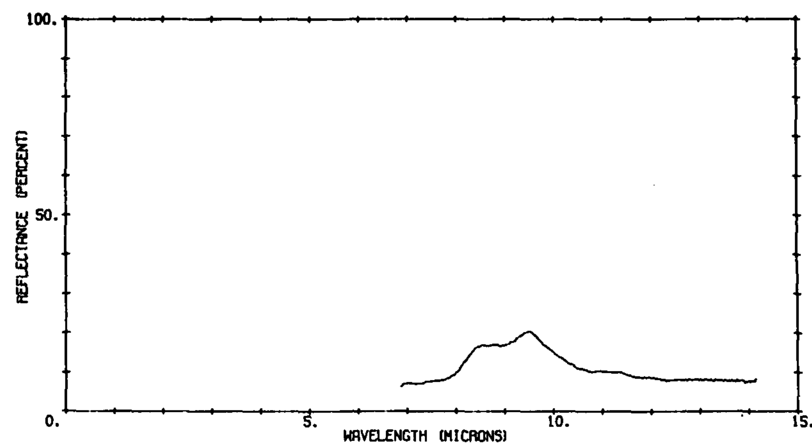
B07139 068

RAWLEY ANDESITE, WEATHERED SURFACE.
VIEWING ANGLE = 60 DEG.



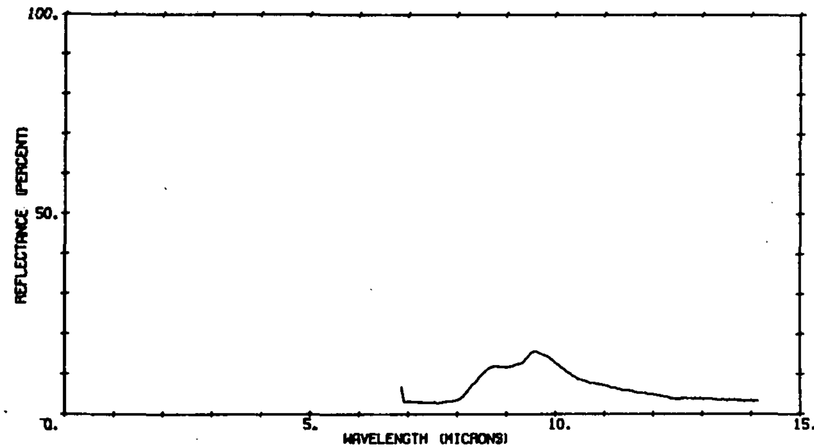
B07139 069

RAWLEY ANDESITE, WEATHERED SURFACE.
VIEWING ANGLE = 75 DEG.



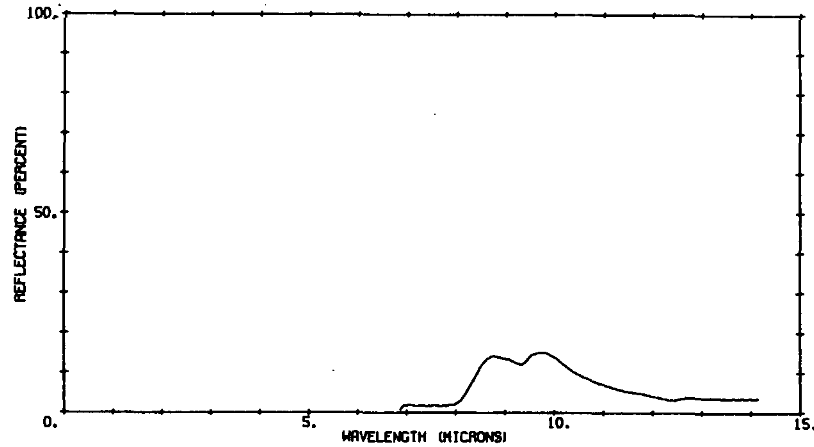
B07139 034

BREWER CREEK LATITE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



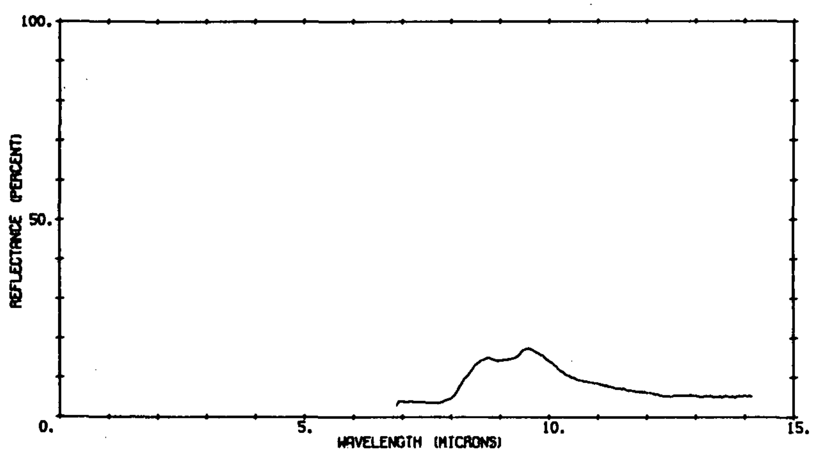
B07139 035

BREWER CREEK LATITE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



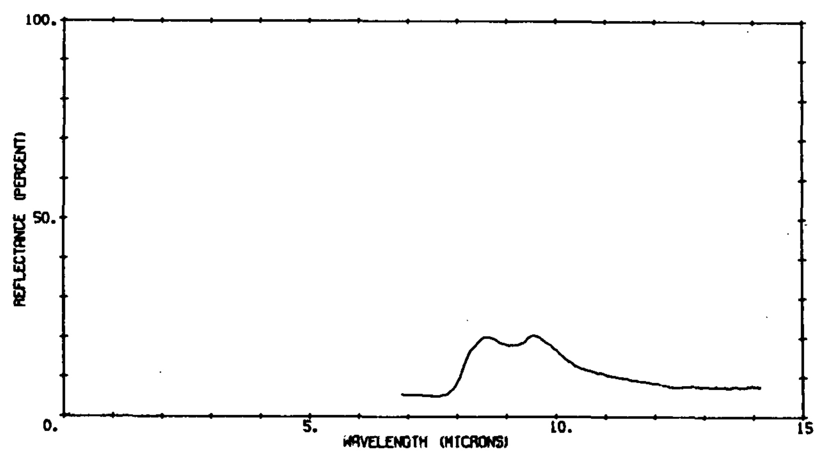
B07139 043

BREWER CREEK LATITE, WEATHER SURFACE.
VIEWING ANGLE = 45 DEG.



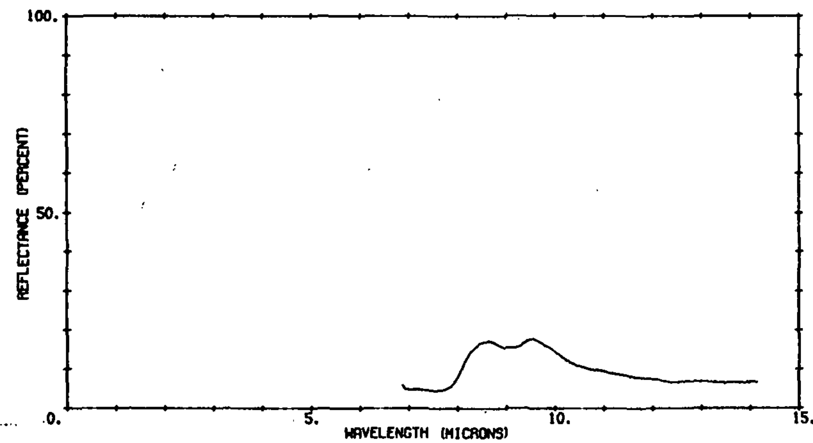
B07139 044

BREWER CREEK LATITE, WEATHER SURFACE.
VIEWING ANGLE = 60 DEG.



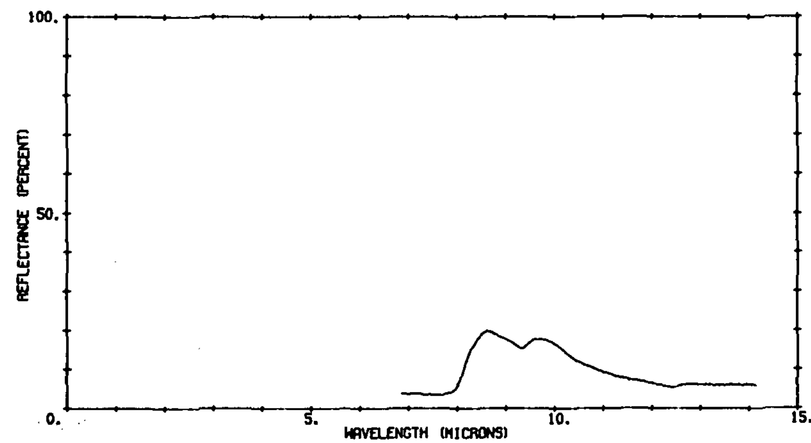
B07139 045

BREWER CREEK LATITE, WEATHER SURFACE.
VIEWING ANGLE = 75 DEG.



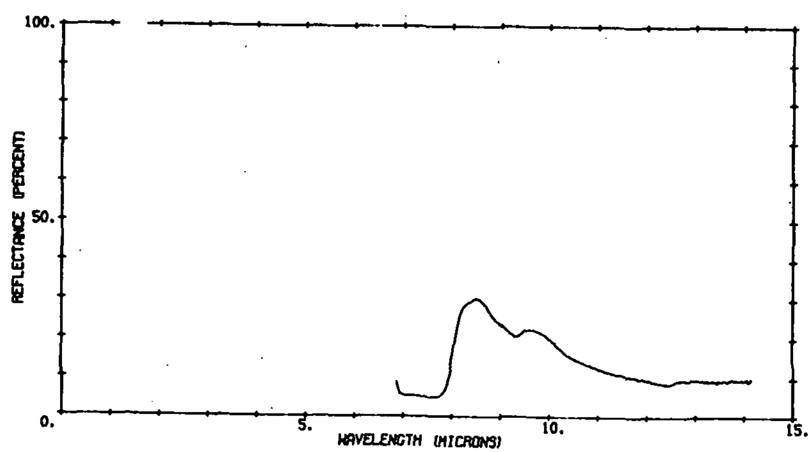
B07139 046

BREWER CREEK LATITE, FRESH SURFACE.
VIEWING ANGLE = 45 DEG.



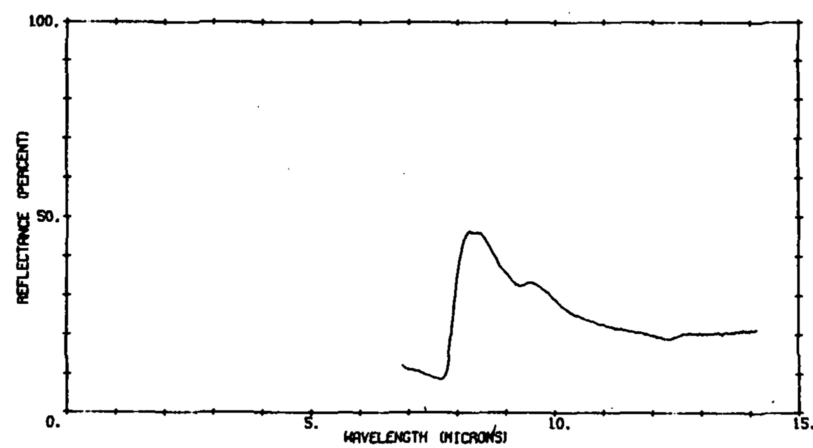
B07139 047

BREWER CREEK LATITE, FRESH SURFACE.
VIEWING ANGLE = 60 DEG.



B07139 048

BREWER CREEK LATITE, FRESH SURFACE.
VIEWING ANGLE = 75 DEG.



103

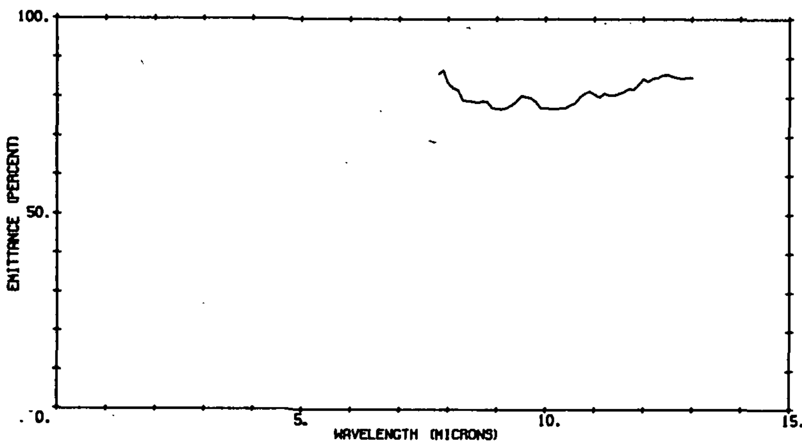
IGNEOUS ROCKS

Basic and Ultrabasic (less than 53% SiO_2) Silicate Rocks

158

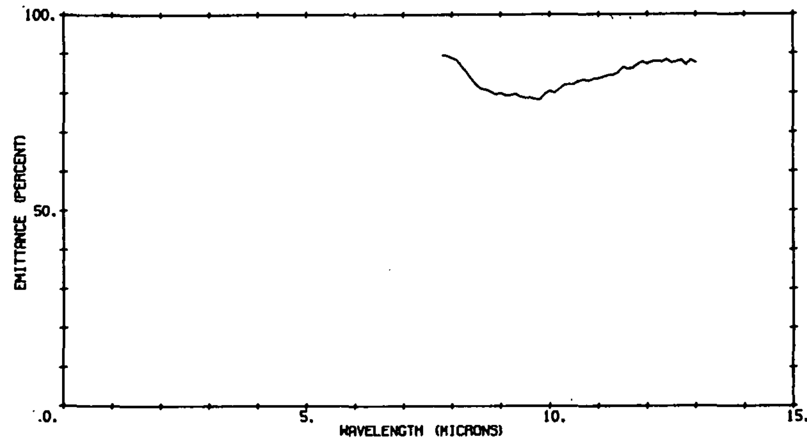
B02131 027

GARNETIFEROUS GABBRO (USNM 109).



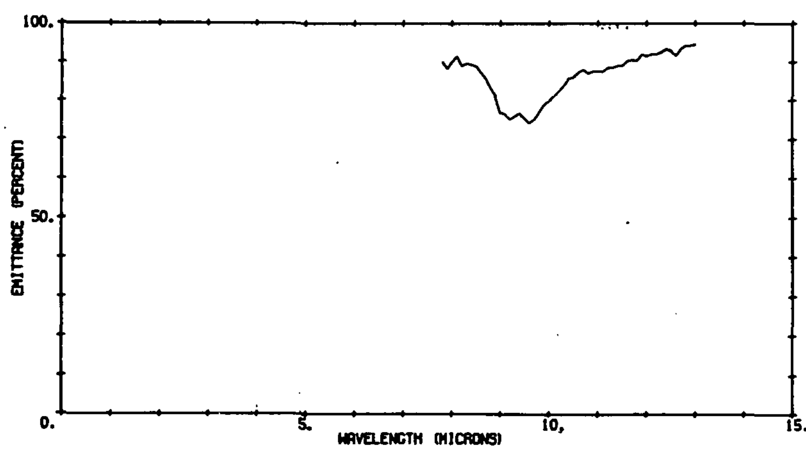
B02131 028

AUGITE DIORITE (GABBRO) (USNM 199).



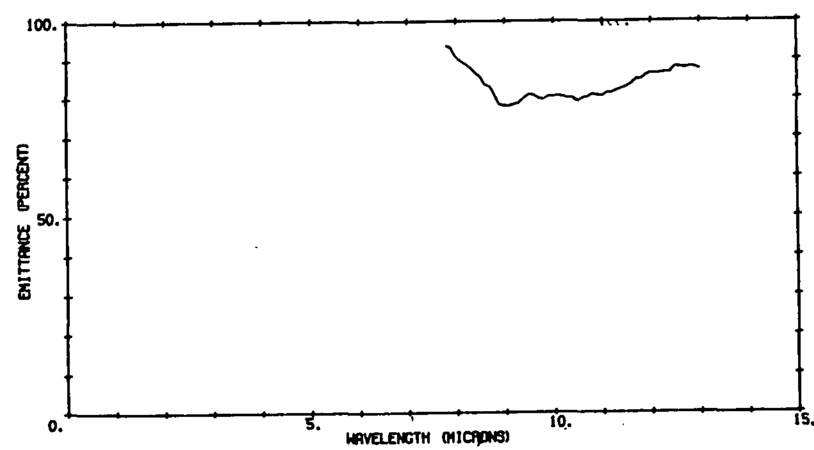
B02131 029

SCHIST (MUSCOVITE-QUARTZ) (USNM 1585).



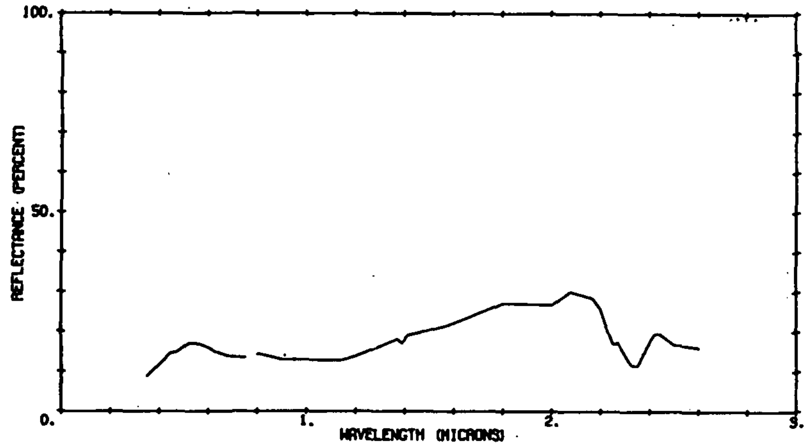
B02131 030

DIABASE (USNM 106).



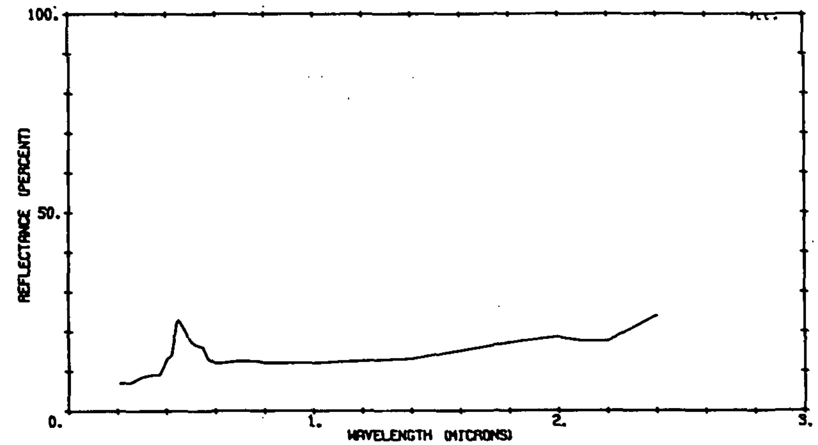
A00261 001

GREENSTONE, ALTERED BASALT.



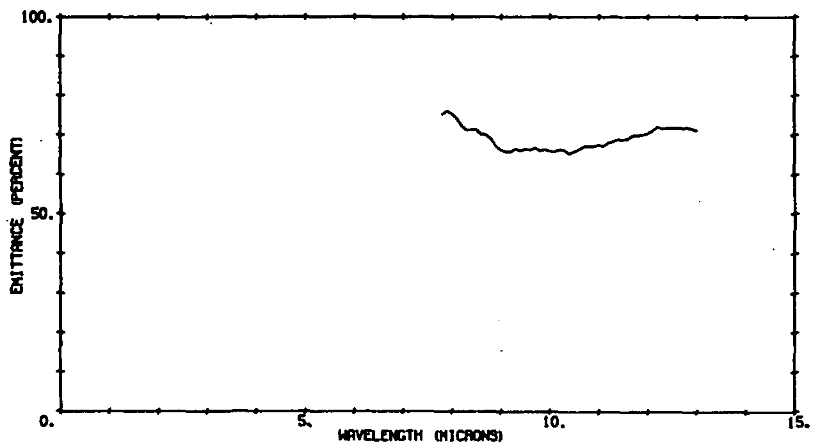
B14004 091

BASALT



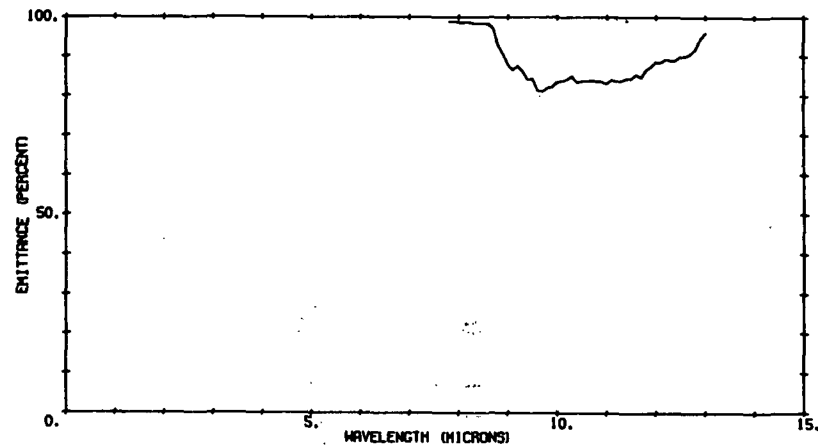
B02131 031

BASALT (USNM 102).

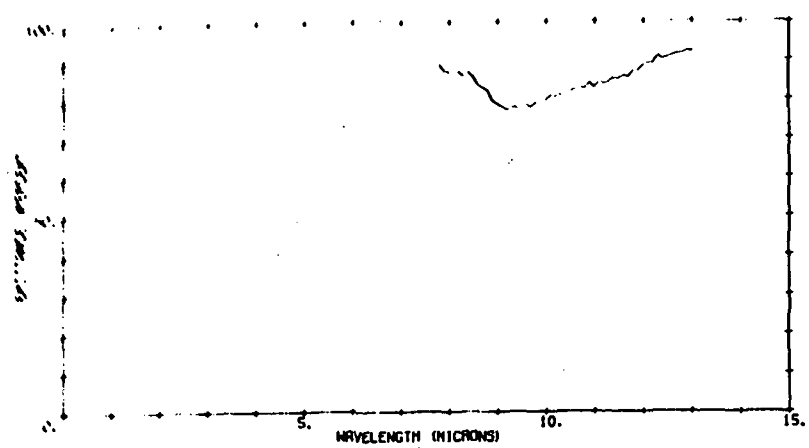


B02131 032

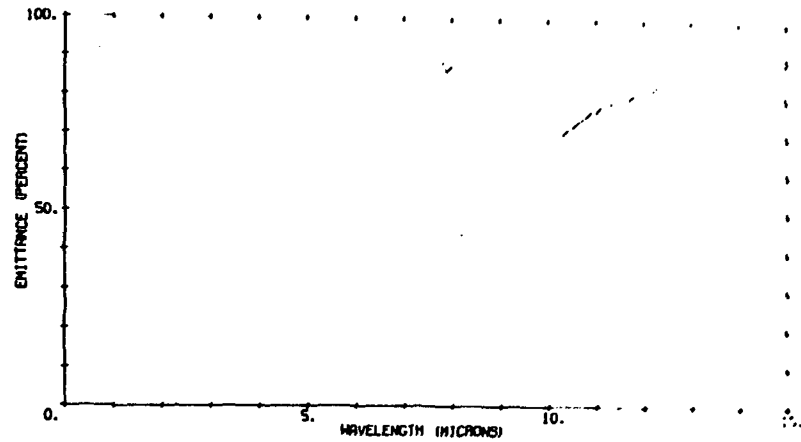
PLAGIOCLASE BASALT (USNM 535).



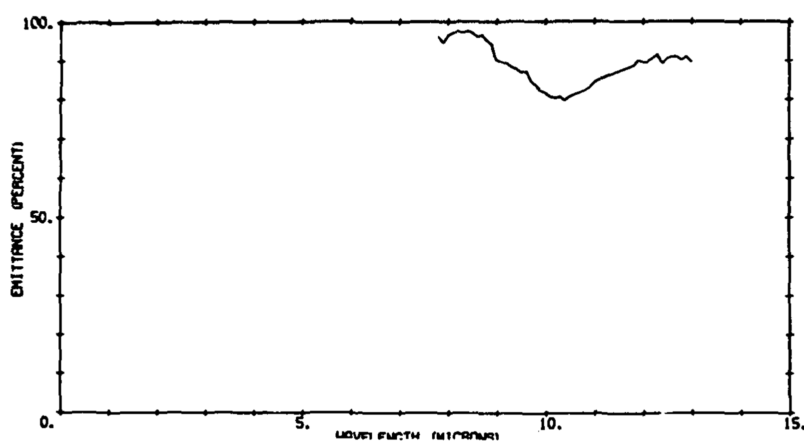
B02131 033



B02131 034

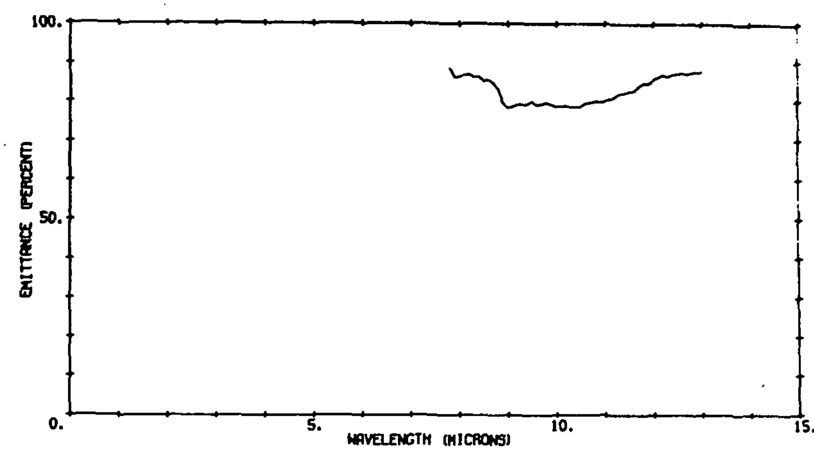


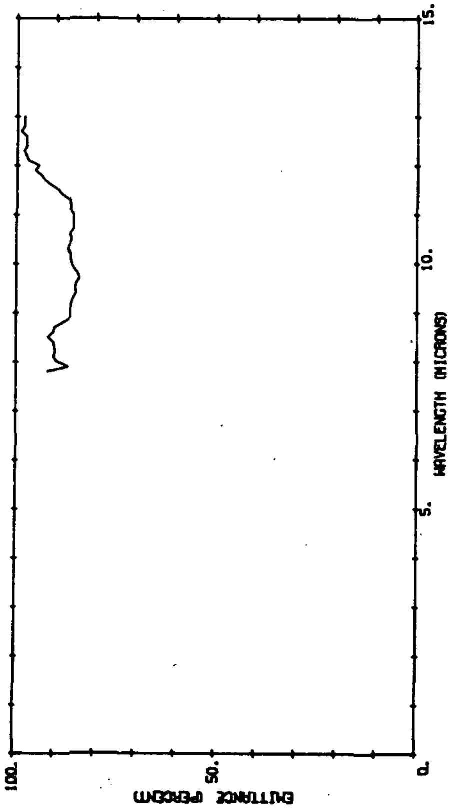
B02131 035



B02131 036

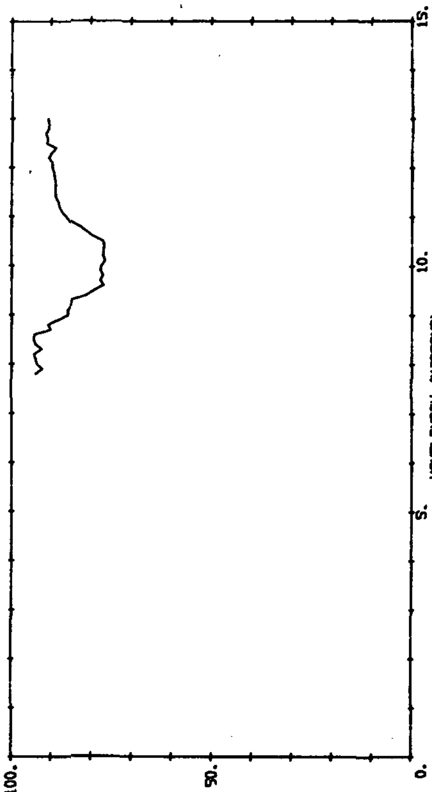
OLIVINE GABBRO (USNM 17341.





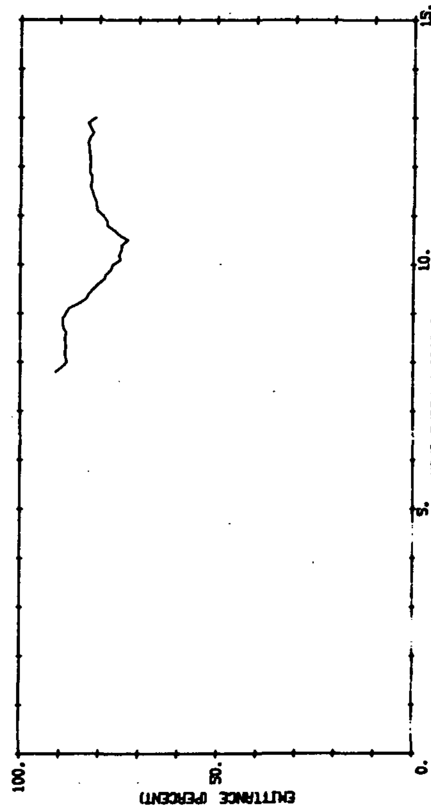
B02131 037

NEPHELINE BASALT (USNM 1065).



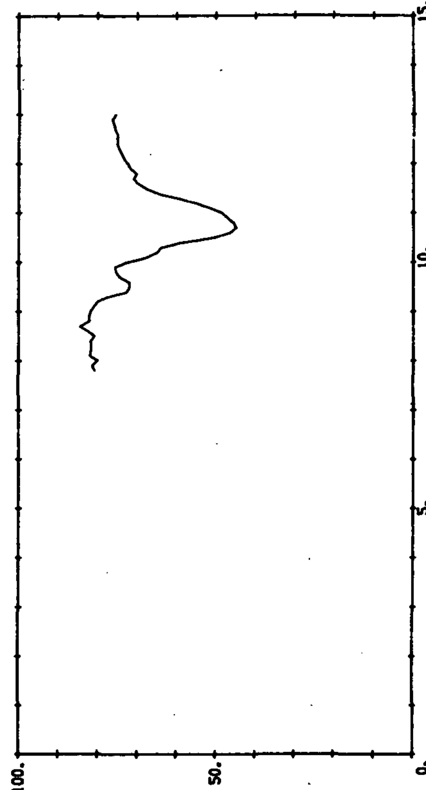
B02131 038

SERPENTINE (USNM 145).



B02131 039

LIMBURGITE (USNM 296).

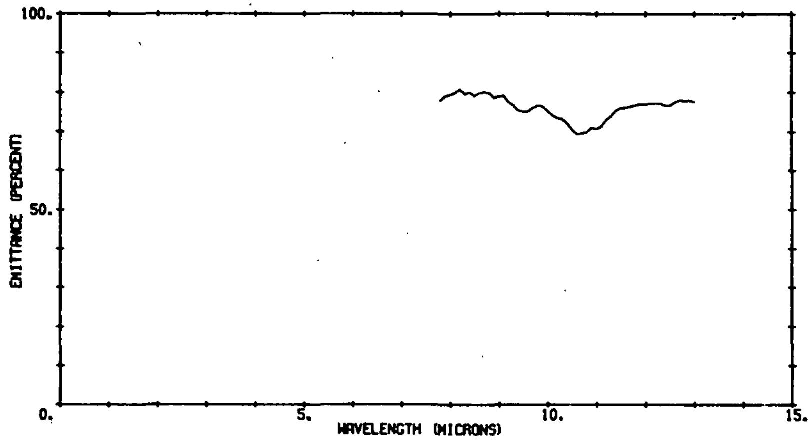


B02131 040

POLISHED DUNITE.

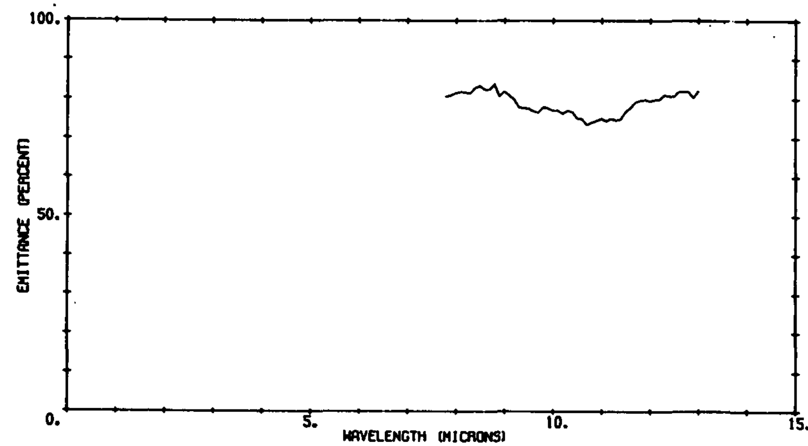
B02131 041

ROUGH DUNITE.



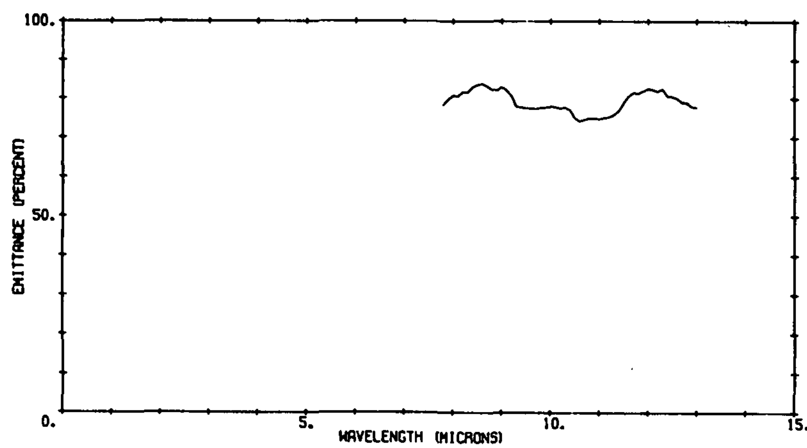
B02131 042

DUNITE GRIT (OVER 850 MICRONS).



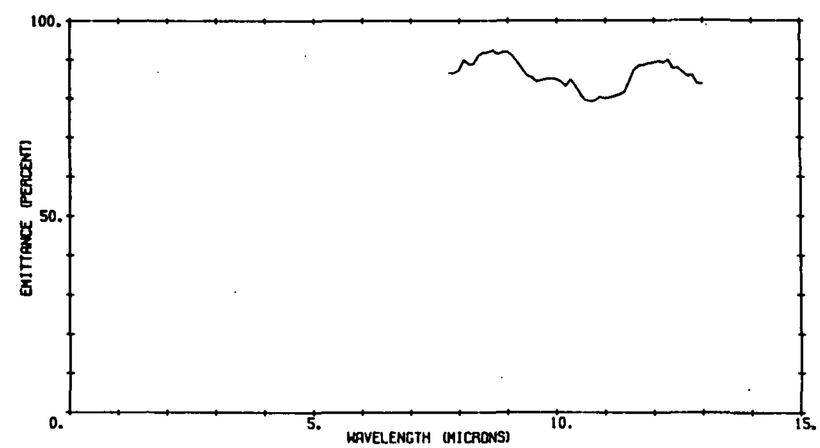
B02131 043

DUNITE SAND (150 TO 300 MICRONS).



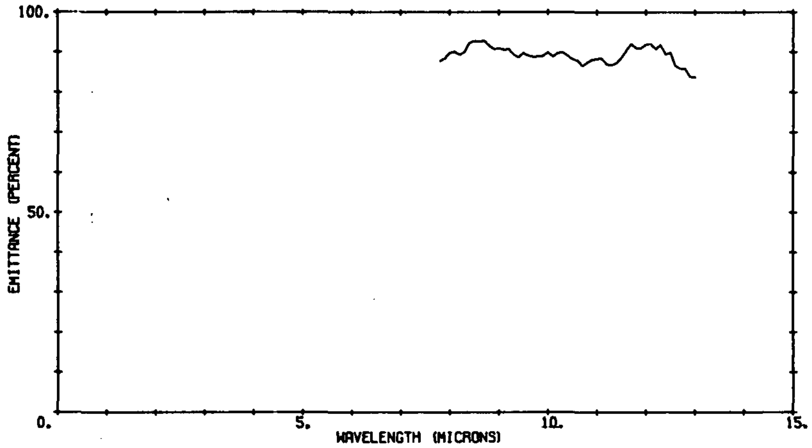
B02131 044

DUNITE DUST (40 TO 80 MICRONS).



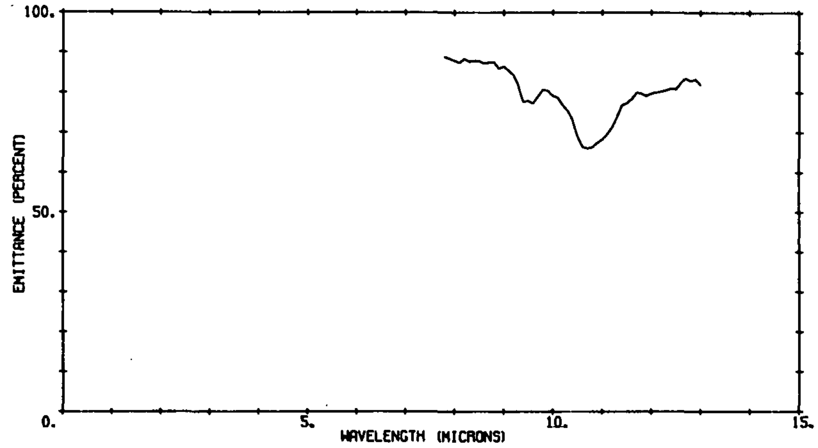
B02131 045

DUNITE POWDER (LESS THAN 1? MICRONS).



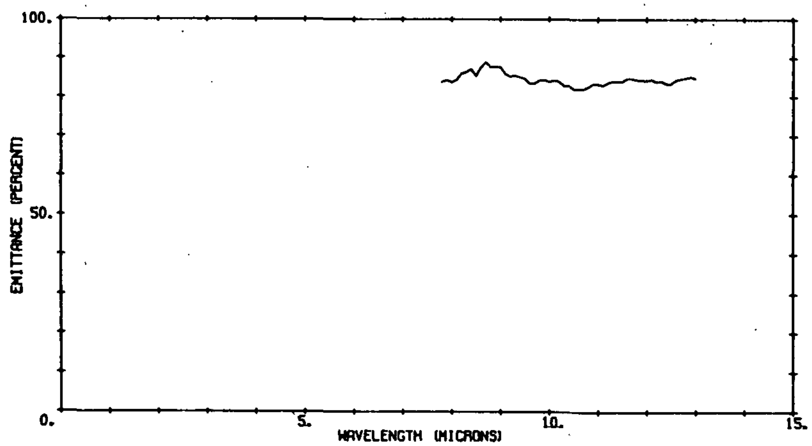
B02131 046

DUNITE SAND.



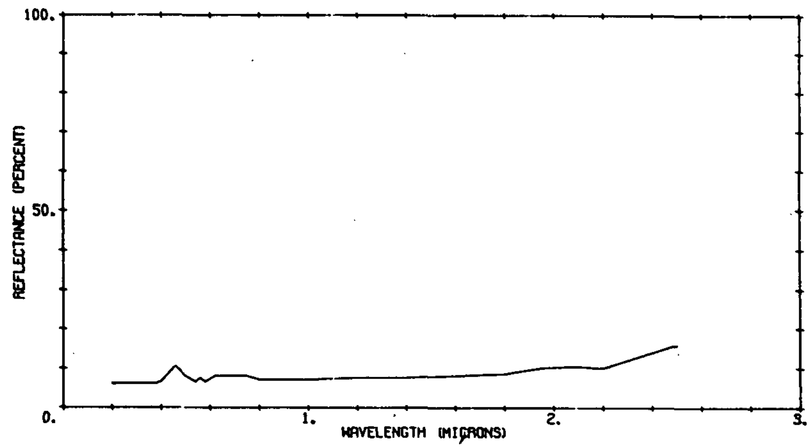
B02131 047

DUNITE DUST.



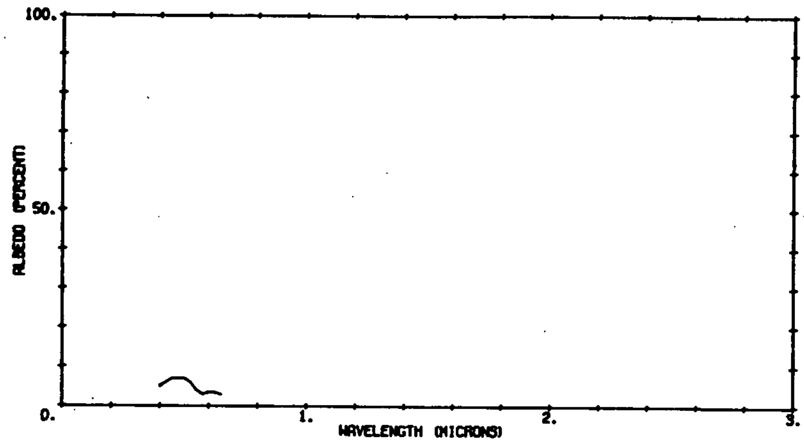
B14004 084

LAVA



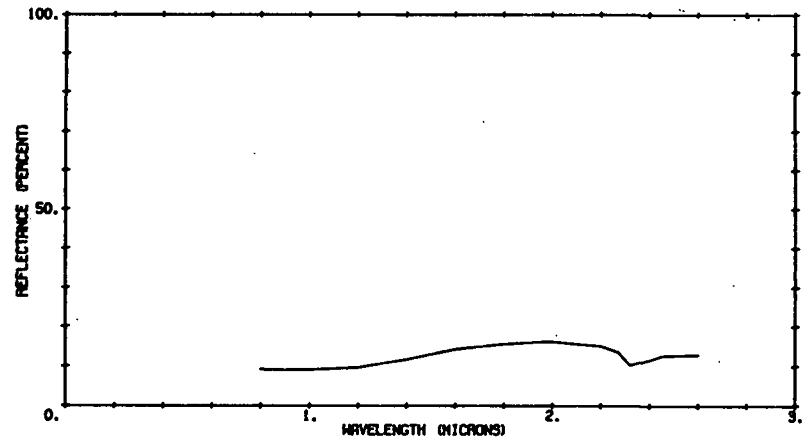
B03258 004

BASALTIC LAVA



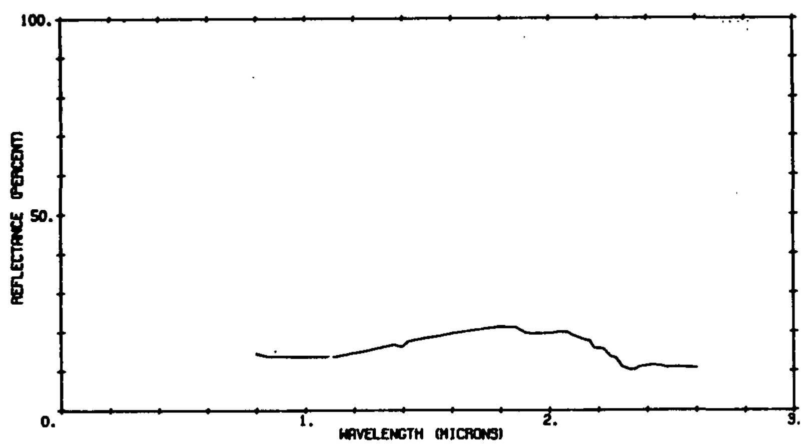
A00260 001

FINE-GRAINED GABBRO.



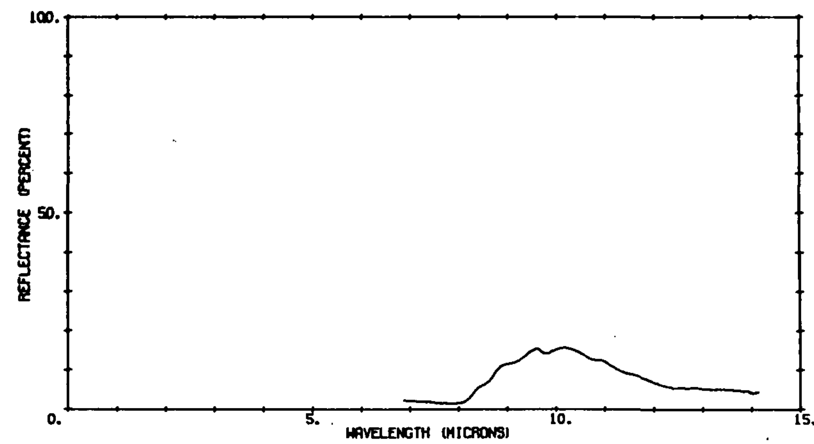
A00262 001

GABBRO.



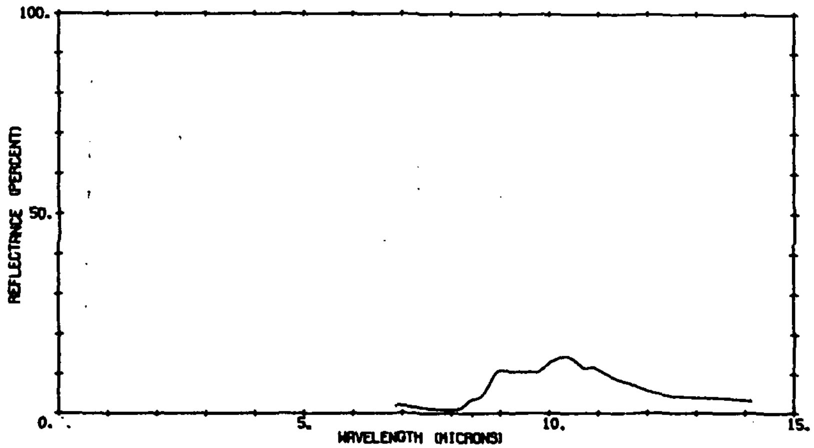
B07139 018

PRECAMBRIAN HORNBLENDE GNEISS, WEATHERED
SURFACE.
VIEWING ANGLE = 15 DEG.



B07139 019

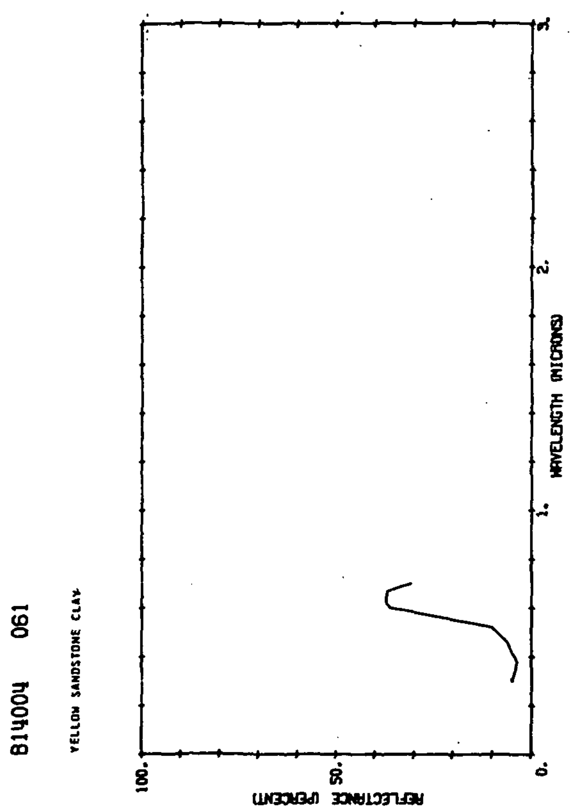
PRECAMBRIAN HORNBLENDE GNEISS, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.

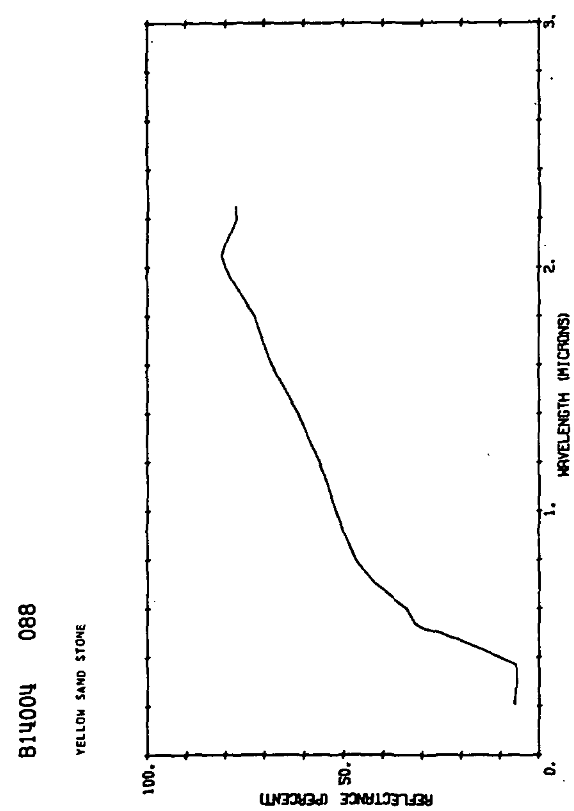


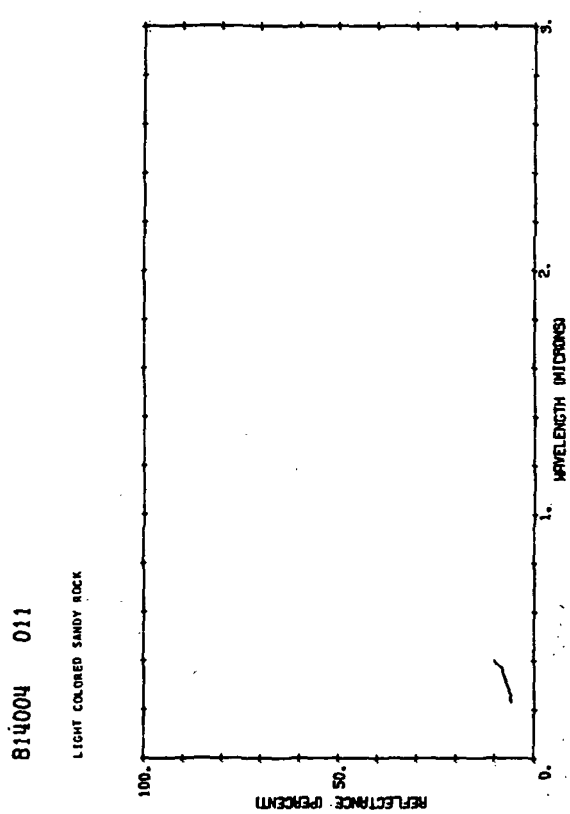
111

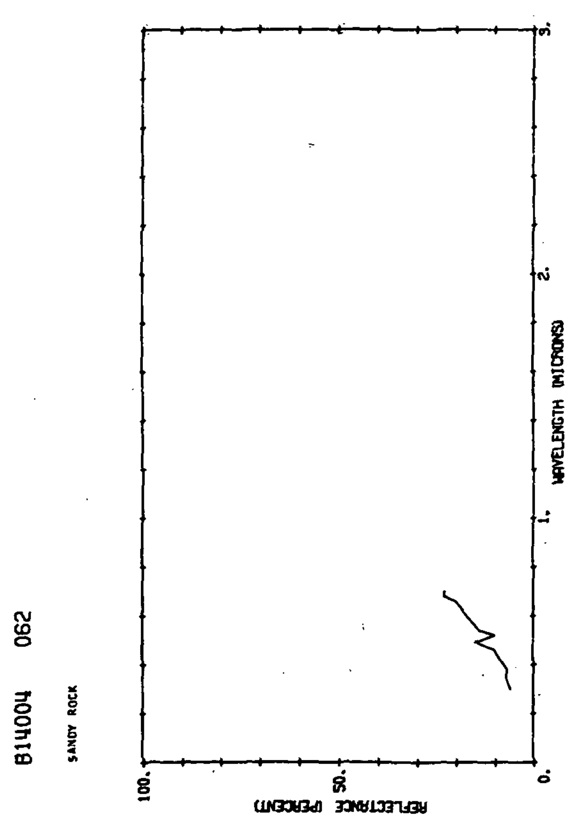
SEDIMENTARY AND METAMORPHIC ROCKS

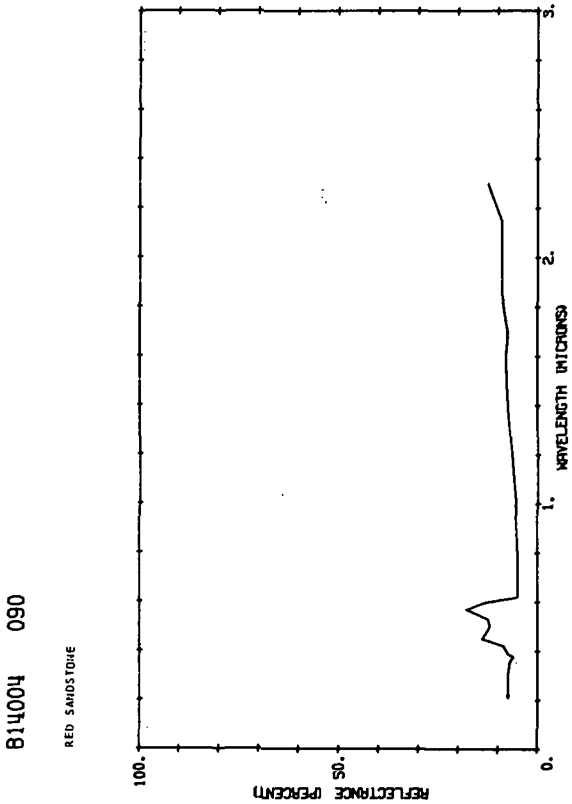
Silicate Sedimentary and Metamorphic Rocks

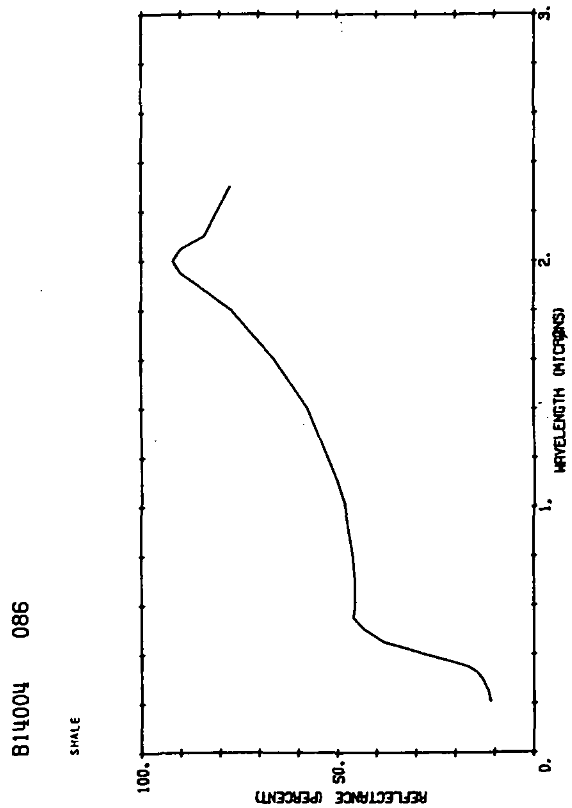

B14004 061
YELLOW SANDSTONE CLAY
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

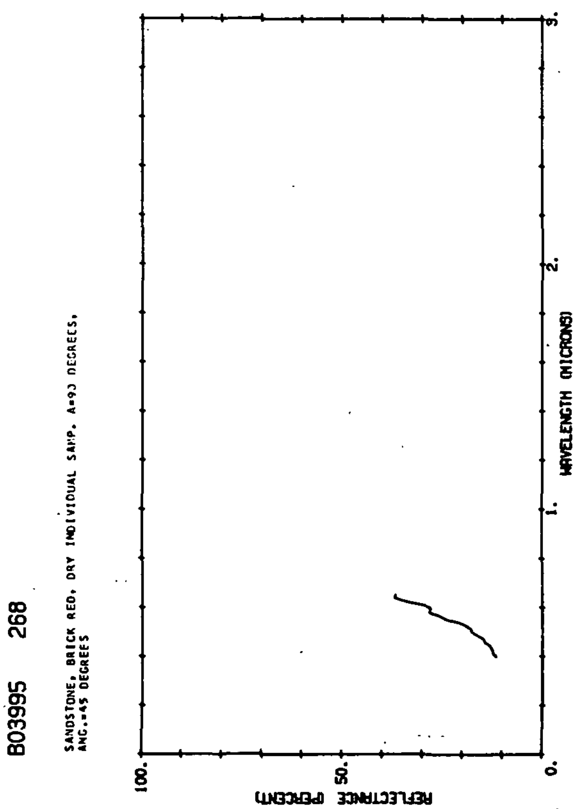

B14004 088
YELLOW SAND STONE
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

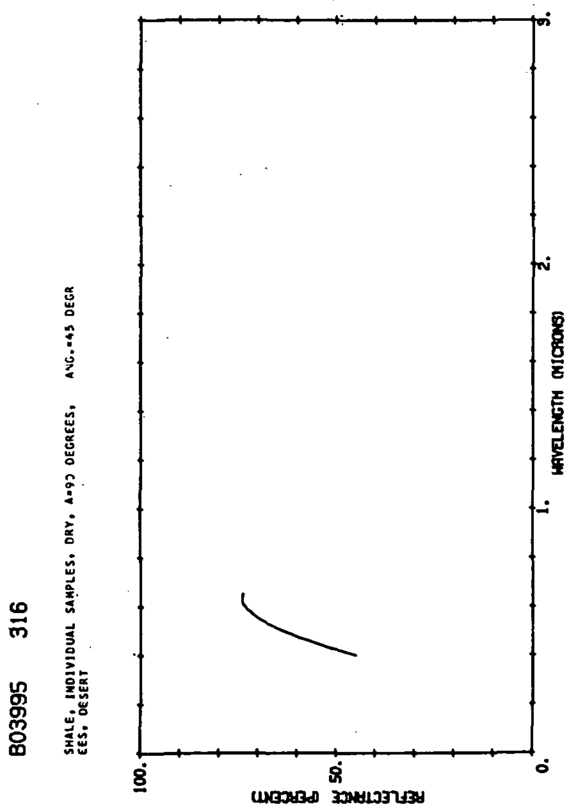

B14004 011
LIGHT COLORED SANDY ROCK
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B14004 062
SANDY ROCK
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B14004 090
RED SANDSTONE
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

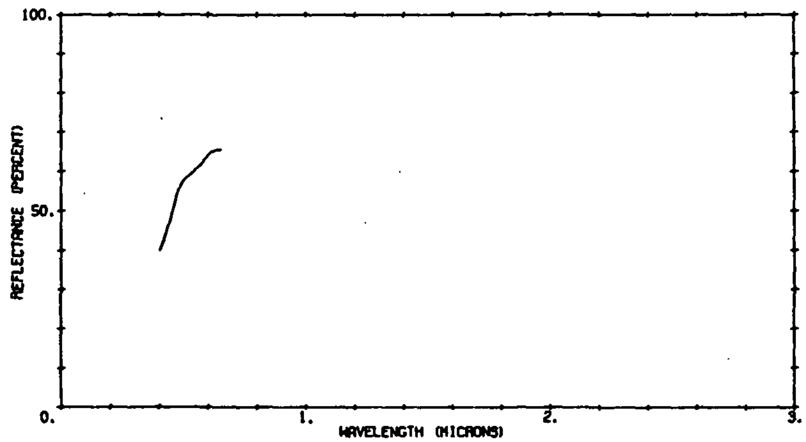

B14004 086
SHALE
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B03995 268
SANDSTONE, BRICK RED, DRY INDIVIDUAL SAMP, A=90 DEGREES,
ANG.=45 DEGREES
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B03995 316
SHALE, INDIVIDUAL SAMPLES, DRY, A=90 DEGREES, ANG.=45 DEGR
EES, DESERT
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

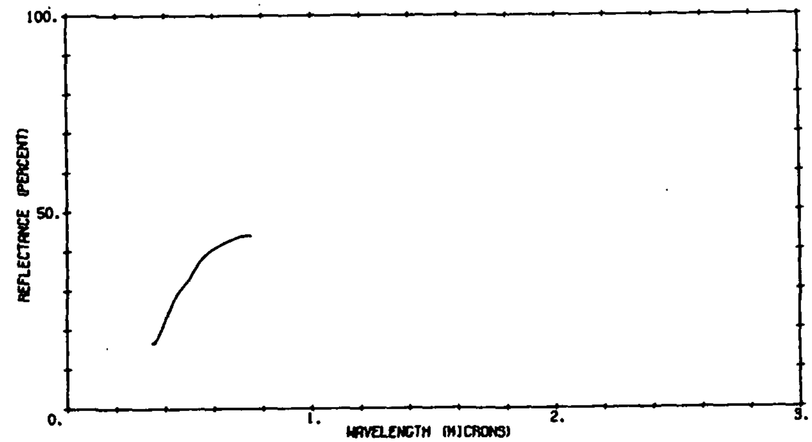
B03995 269

SANDSTONE, LIGHT GREY, DRY INDIVIDUAL SAMP. A=90 DEGREES, ANG.=45 DEGREES



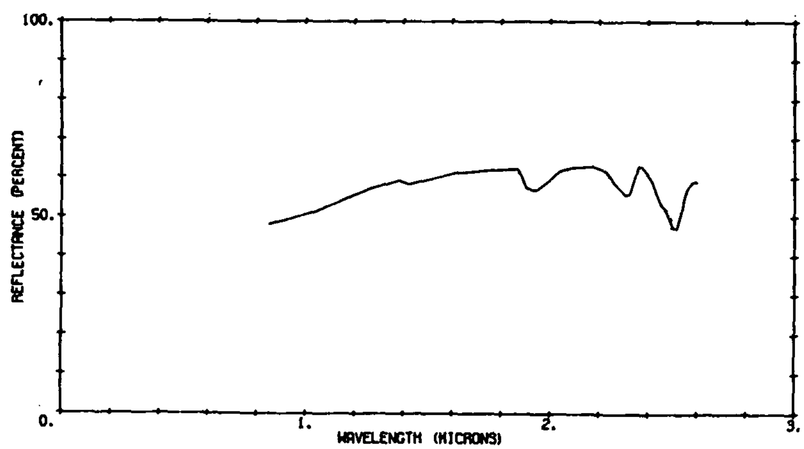
A00264 001

SILTSTONE.



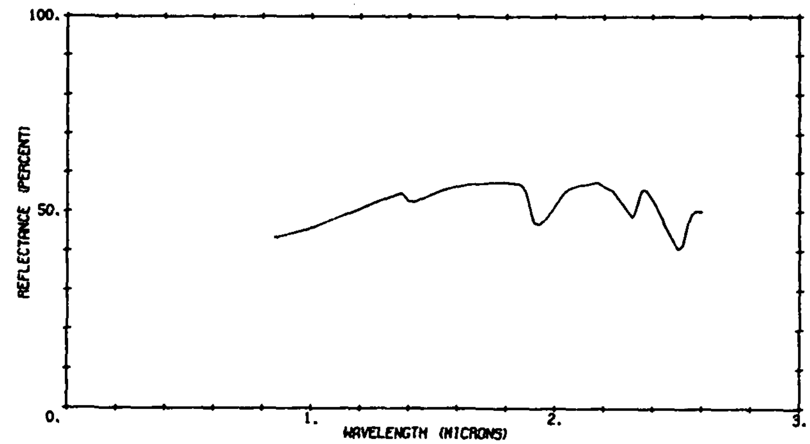
A00264 002

SILTSTONE, FRESH CLEAVED SURFACE.



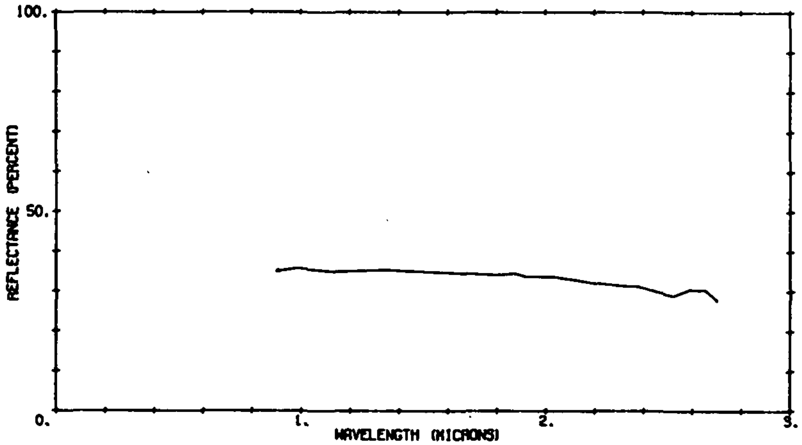
A00264 003

SILTSTONE, NATURAL WEATHERED SURFACE.



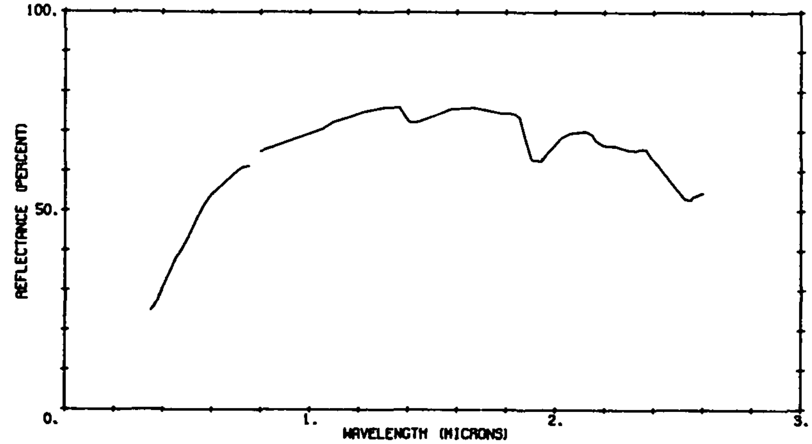
A00265 001

SILTSTONE.



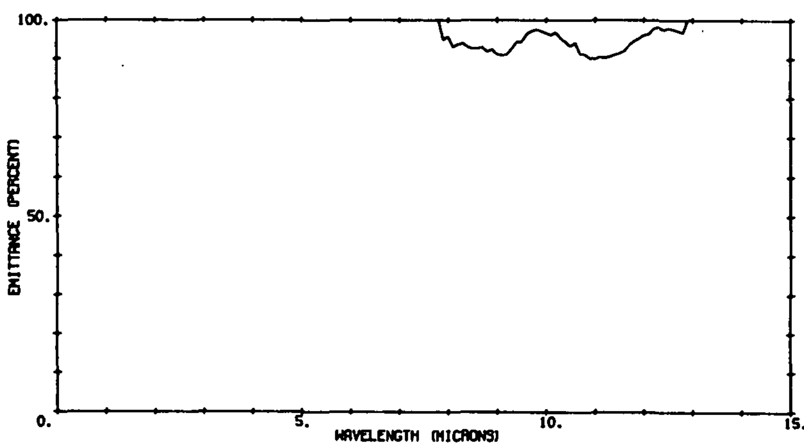
A00263 001

CHERT.



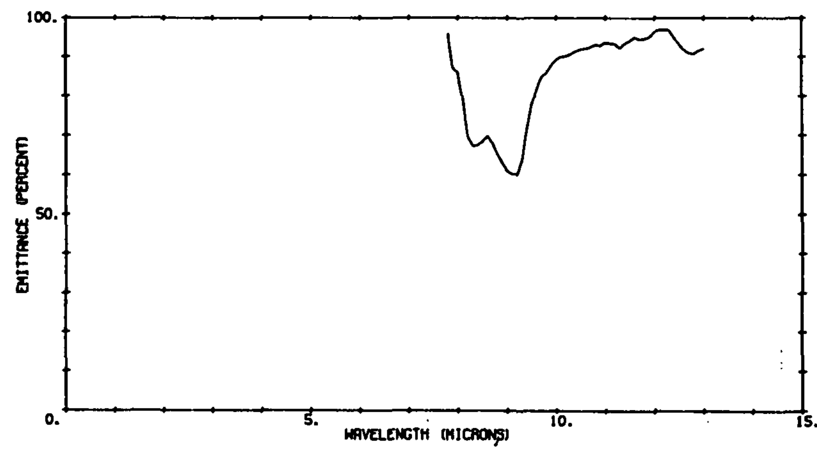
B02131 003

CHERT.

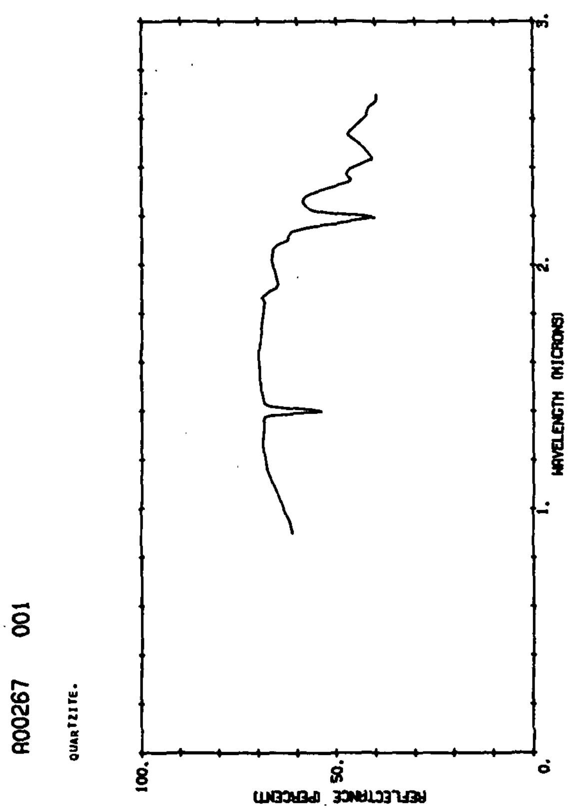


B02131 005

FINE GRAINED CHERT.



G 4


R00267 001
QUARTZITE.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

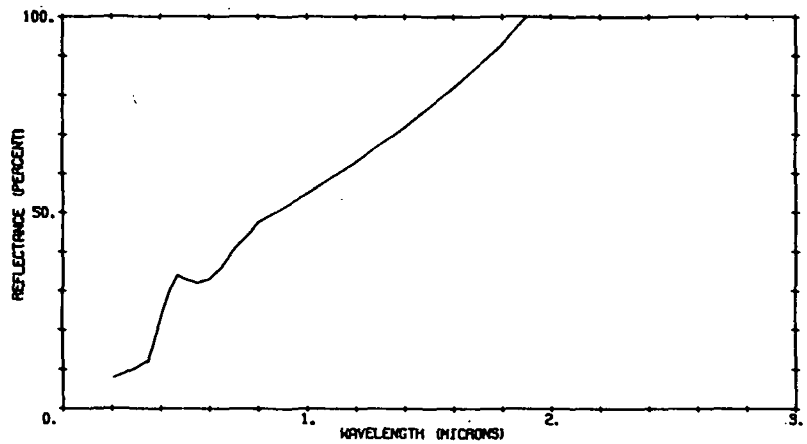
112

SEDIMENTARY AND METAMORPHIC ROCKS

Carbonate Sedimentary and Metamorphic Rocks

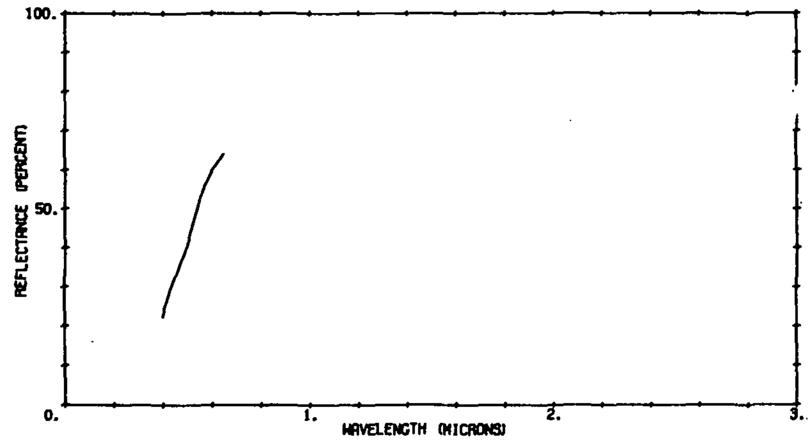
B14004 087

LIMESTONE



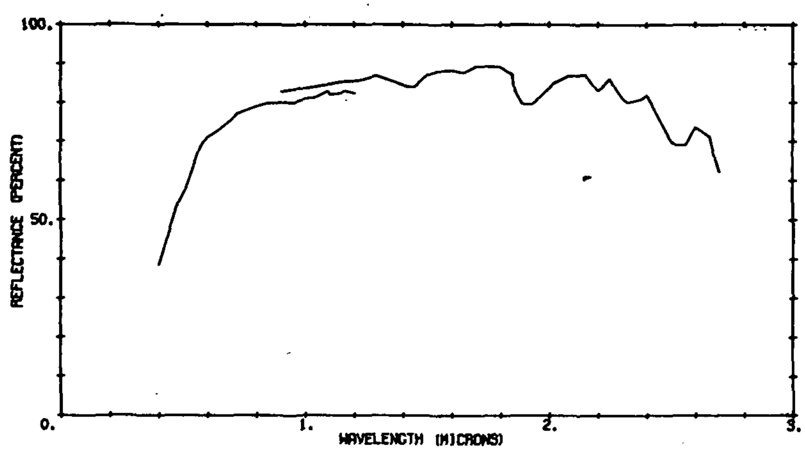
B03995 236

LIMESTONE, DRY, SINGLE SAMPLE, A=30 DEGREES, ANG.=45 DEGREES



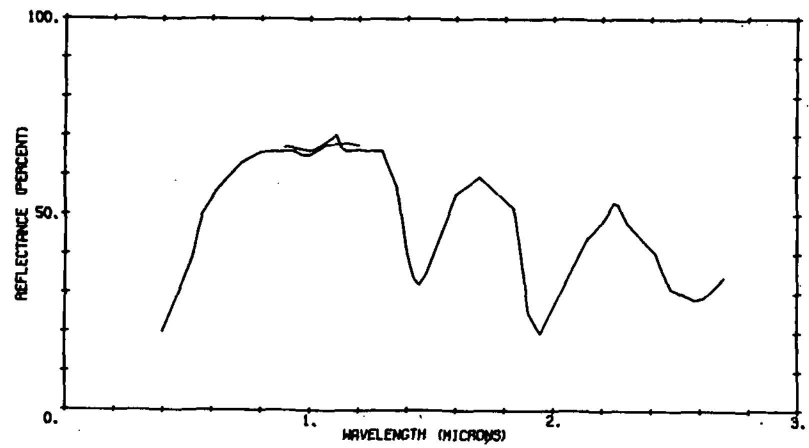
B00830 179

LIMESTONE, WHITE AND SOFT UNDER GREENVILLE LOAM, GEORGIA, DRY



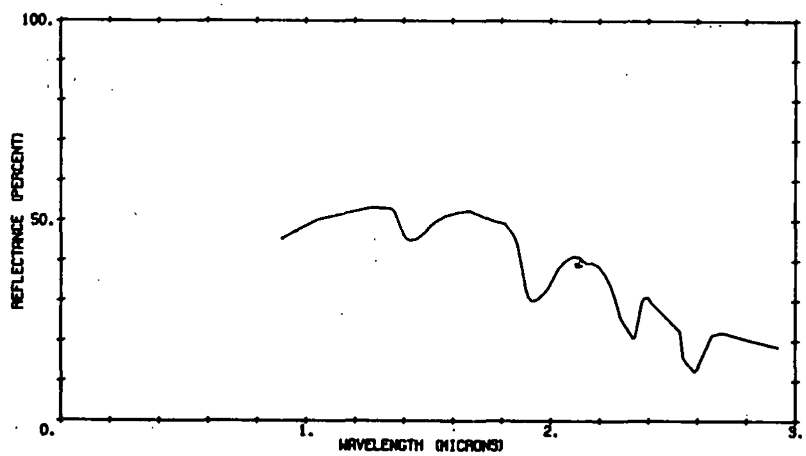
B00830 181

LIMESTONE, WHITE AND SOFT UNDER GREENVILLE LOAM, GEORGIA, WET



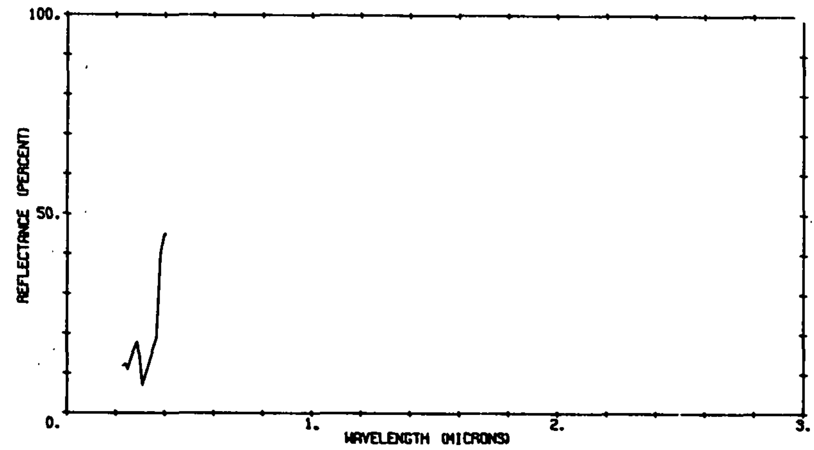
A00268 001

CORAL.



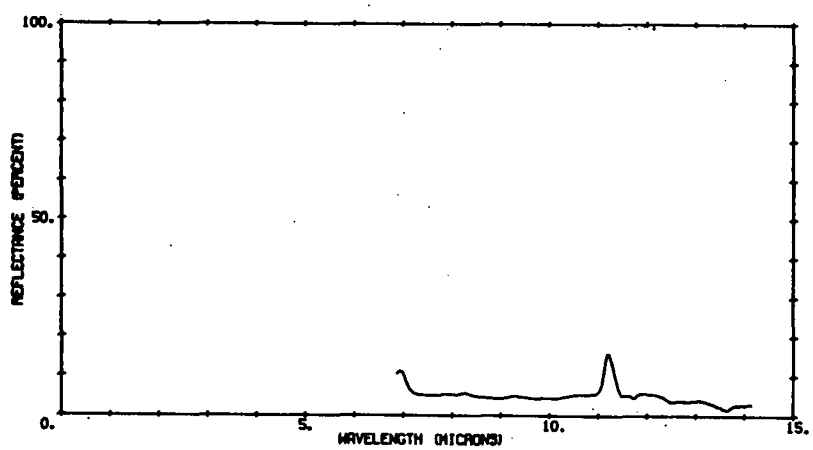
B14004 012

DRY WHITE CORAL



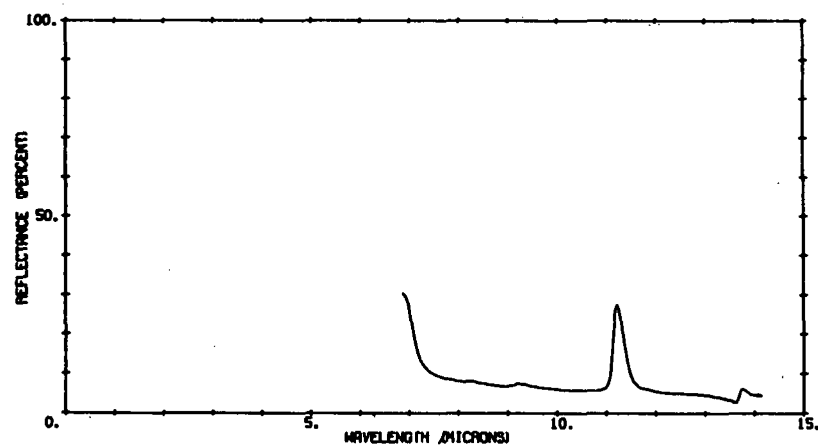
B07139 013

MANITOU LIMESTONE, WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



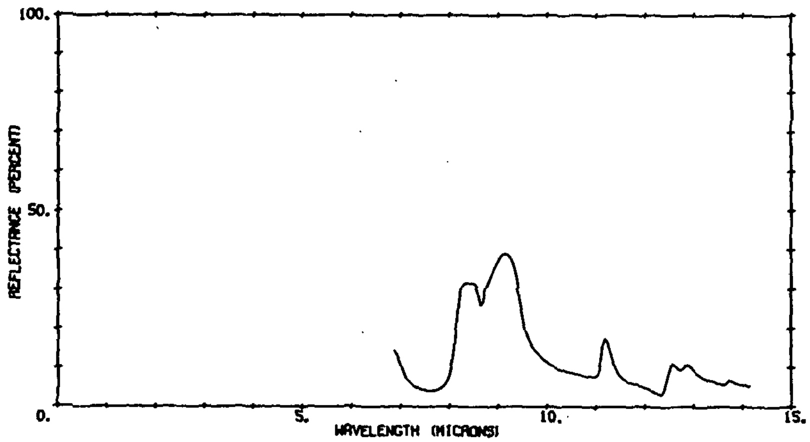
B07139 014

MANITOU LIMESTONE, FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



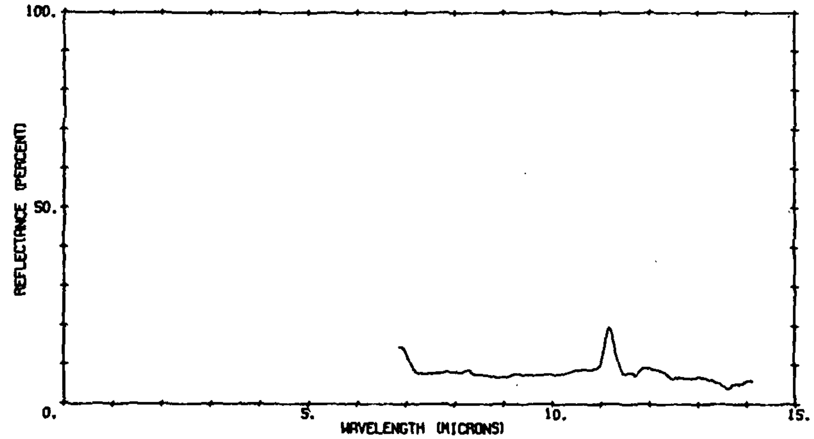
B07139 015

MANITOU LIMESTONE, BOUNDARY OF CHERT NODULE
AND CABONATE MATERIAL.
VIEWING ANGLE = 15 DEG.



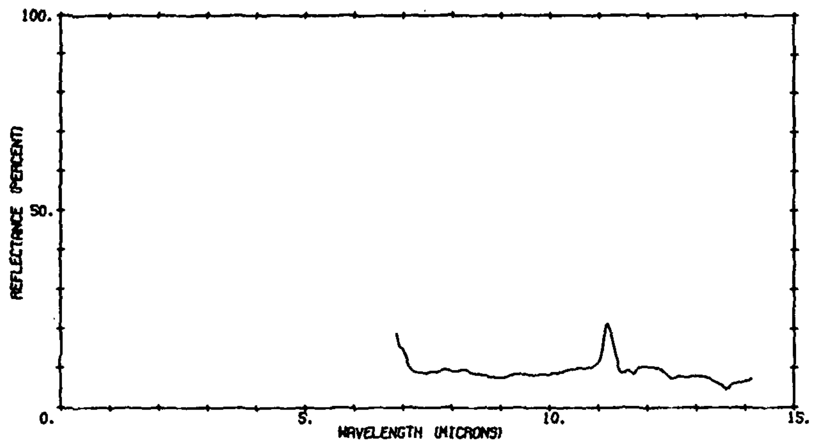
B07139 055

MANITOU LIMESTONE, WEATHER SURFACE.
VIEWING ANGLE = 45 DEG.



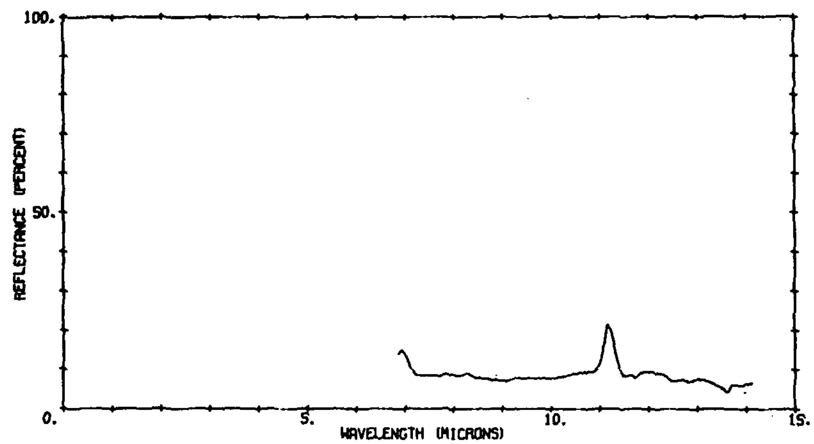
B07139 056

MANITOU LIMESTONE, WEATHER SURFACE.
VIEWING ANGLE = 60 DEG.



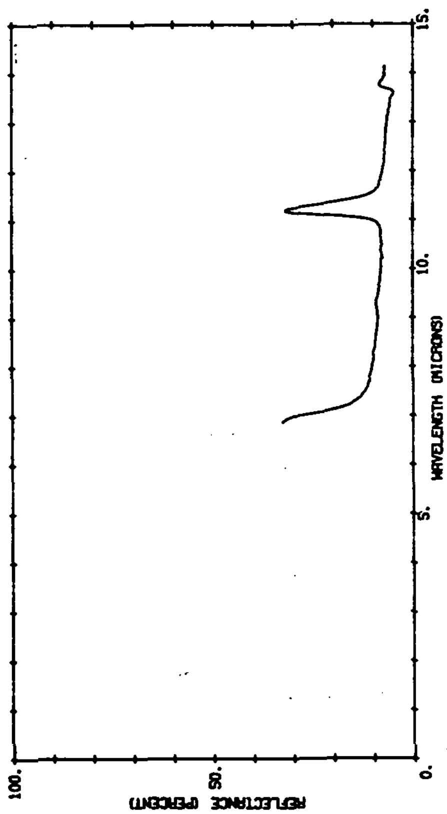
B07139 057

MANITOU LIMESTONE, WEATHER SURFACE.
VIEWING ANGLE = 75 DEG.



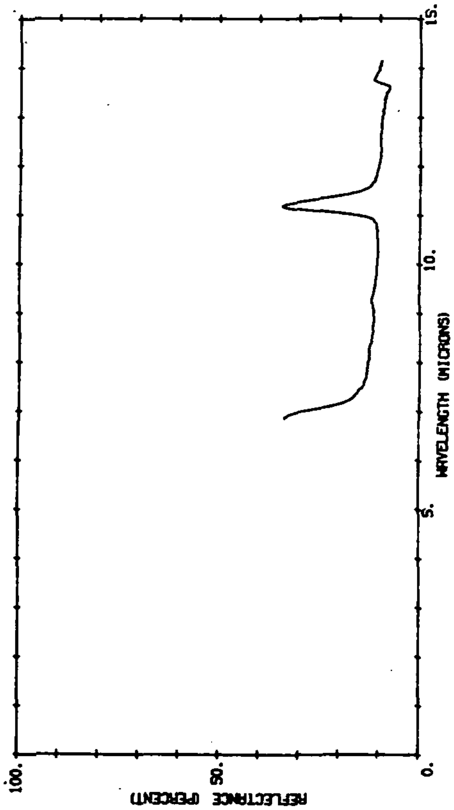
B07139 058

MANITOU LIMESTONE, FRESH SURFACE.
VIEWING ANGLE = 45 DEG.



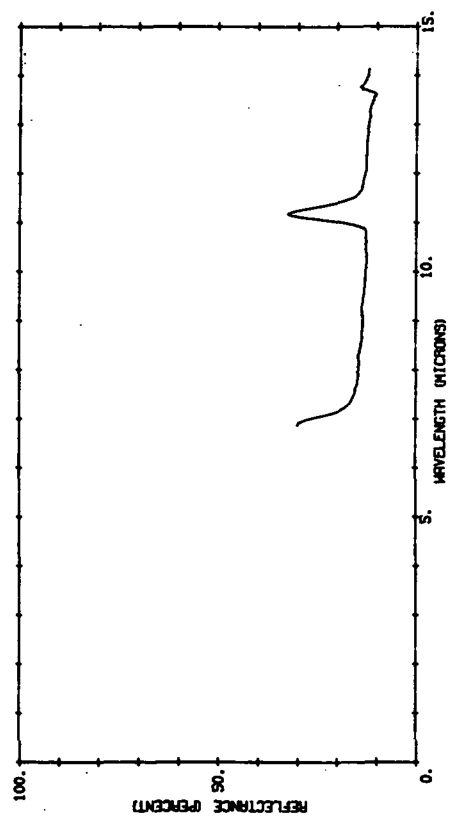
B07139 059

MANITOU LIMESTONE, FRESH SURFACE.
VIEWING ANGLE = 60 DEG.



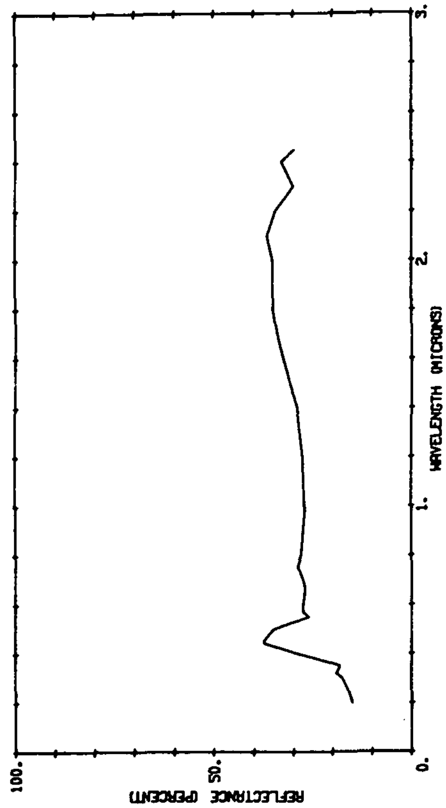
B07139 060

MANITOU LIMESTONE, FRESH SURFACE.
VIEWING ANGLE = 75 DEG.



B14004 094

MARBLE



121

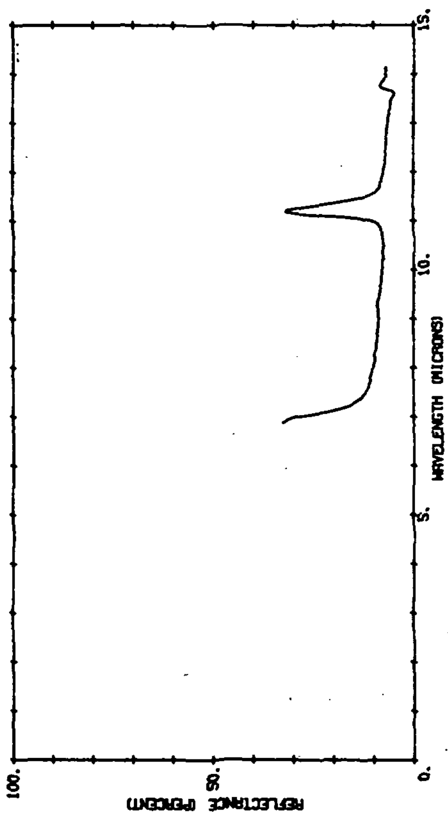
MINERALS

Silicate Minerals

178

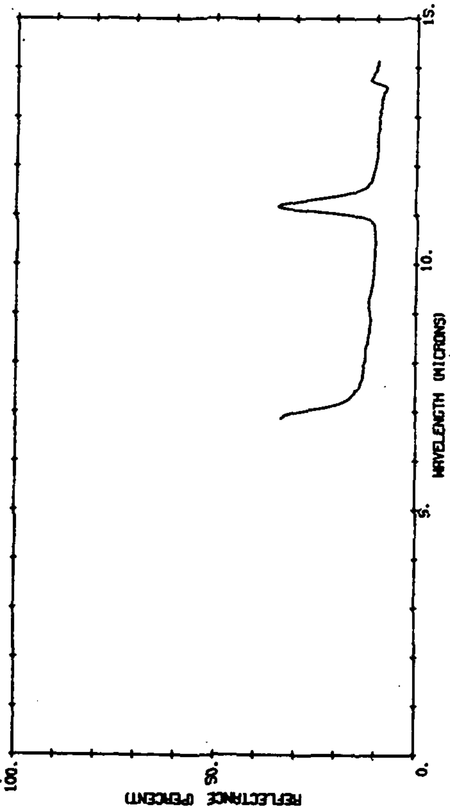
B07139 058

MANITOU LIMESTONE, FRESH SURFACE.
VIEWING ANGLE = 45 DEG.



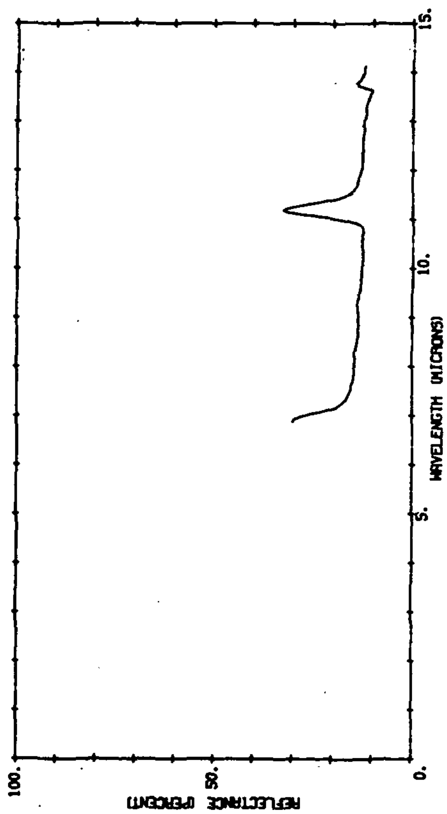
B07139 059

MANITOU LIMESTONE, FRESH SURFACE.
VIEWING ANGLE = 60 DEG.



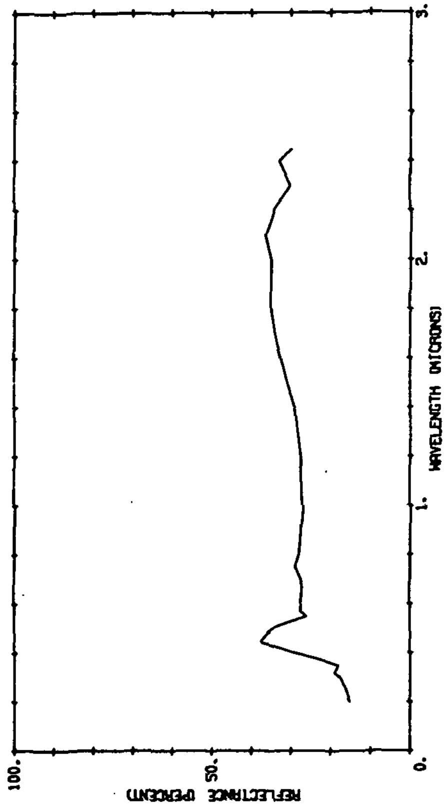
B07139 060

MANITOU LIMESTONE, FRESH SURFACE.
VIEWING ANGLE = 75 DEG.



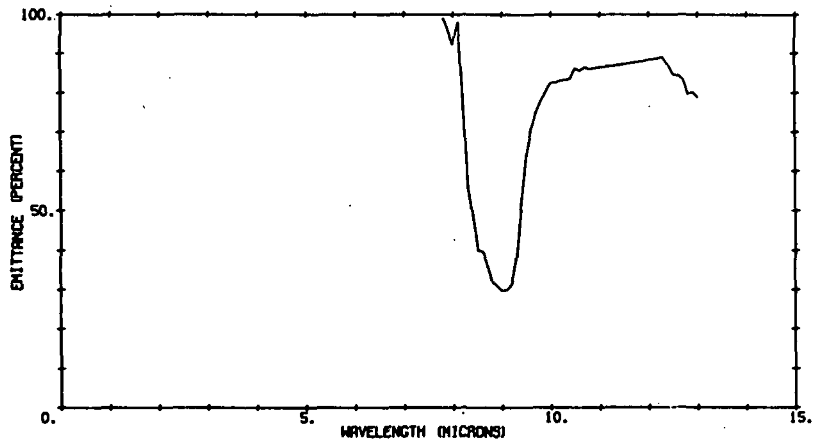
B14004 094

MARBLE



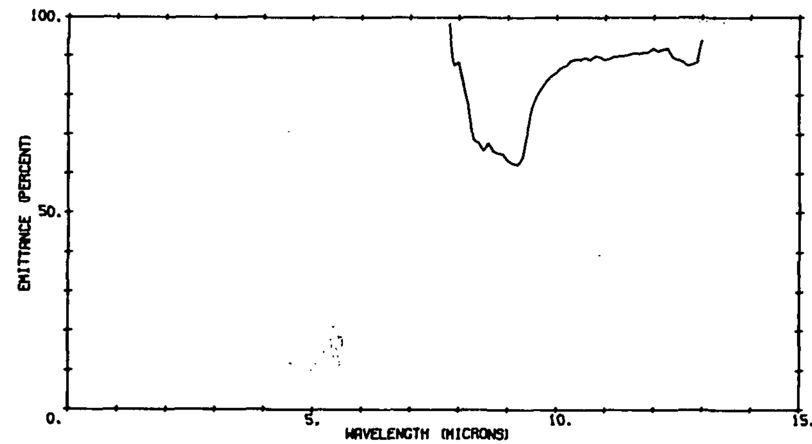
B02131 001

POLISHED QUARTZ



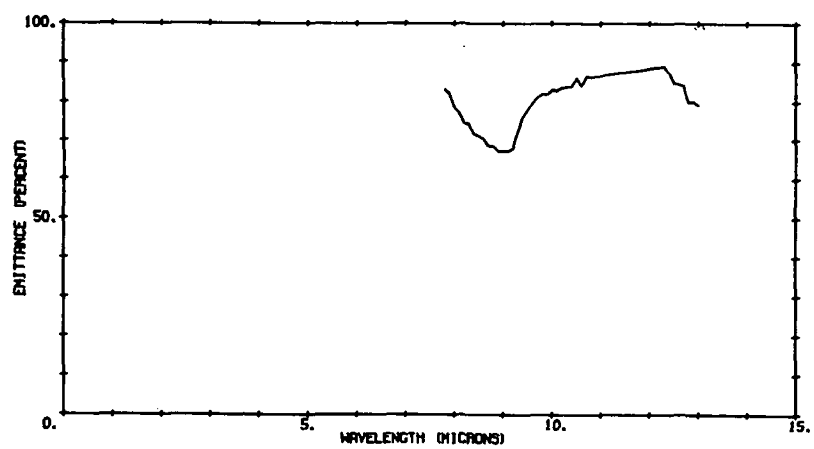
B02131 002

ROUGHENED QUARTZ PLATE (X-CUT).



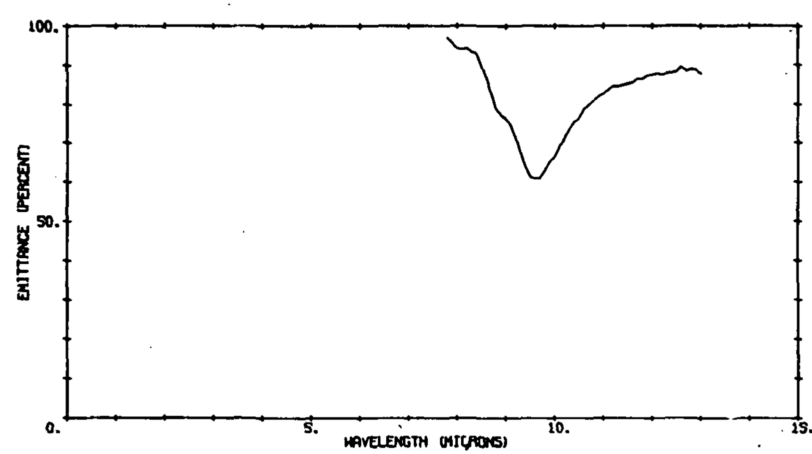
B02131 004

QUARTZ SAND



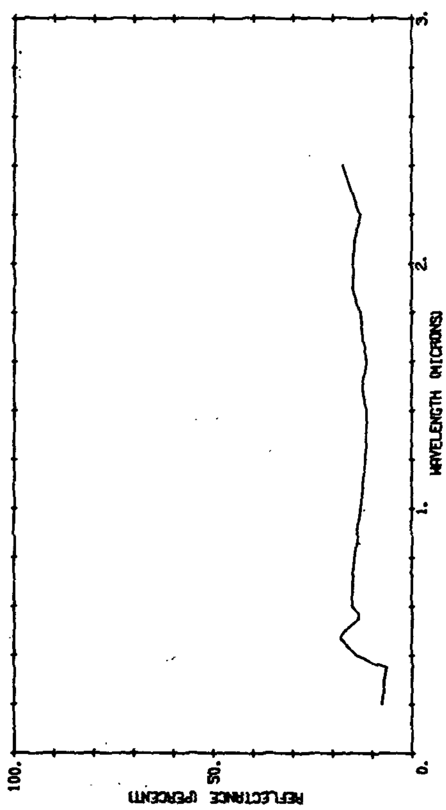
B02131 052

A CLEAVAGE FRAGMENT OF K-FELDSPAR.



B14004 093

GRAY FELDSPAR



123

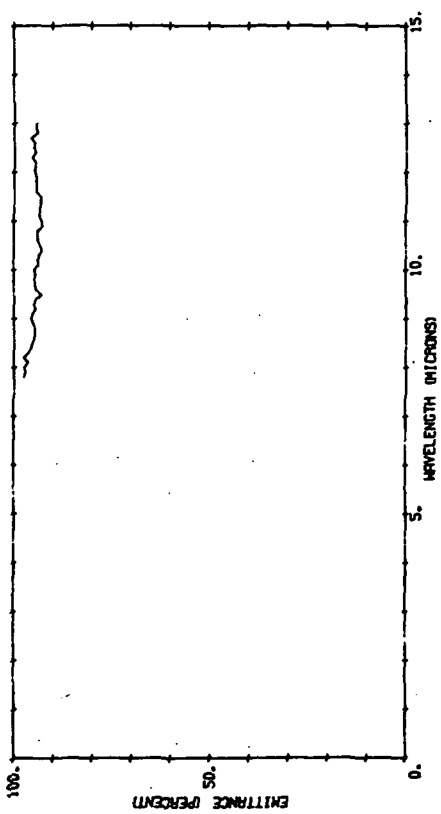
MINERALS

Accessory Minerals

181

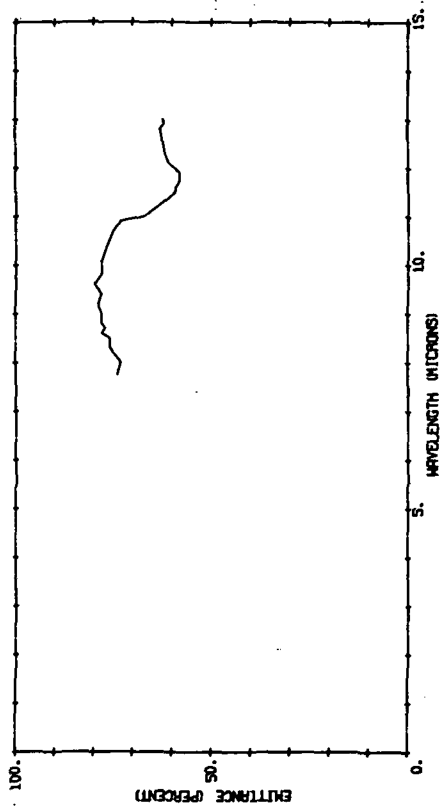
B02131 057

ALUMINA (SAPHIRE)--POWDER OF 0.02 MICRONS.



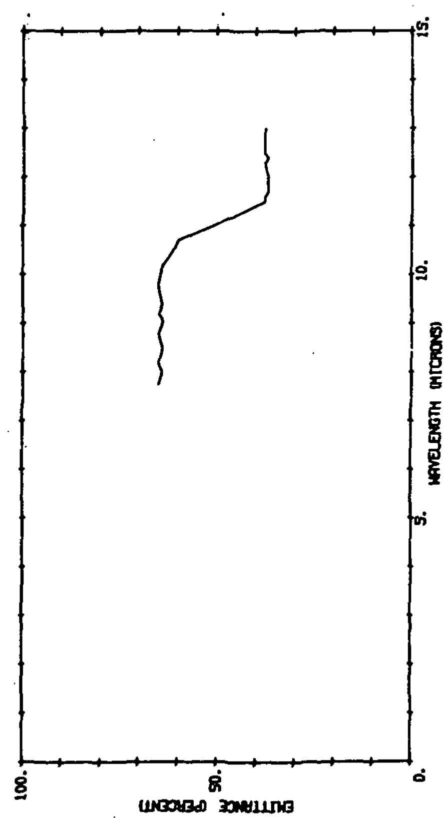
B02131 058

ALUMINA (SAPHIRE)--TUBING.



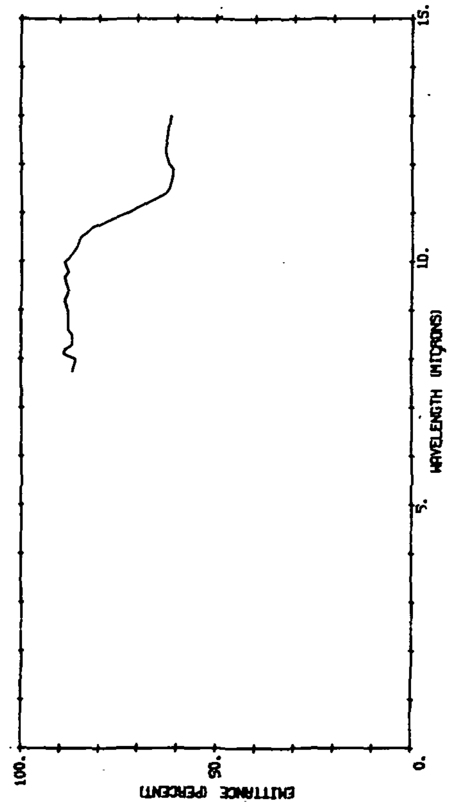
B02131 059

ALUMINA (SAPHIRE)--PLATELETS.



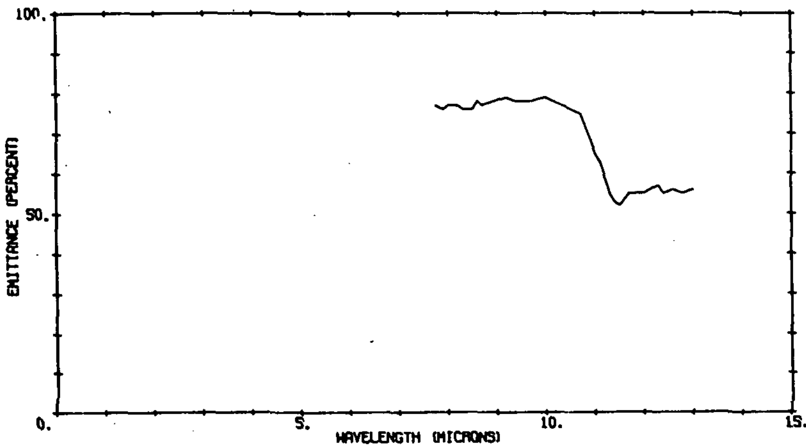
B02131 060

ALUMINA (SAPHIRE)--ROD.



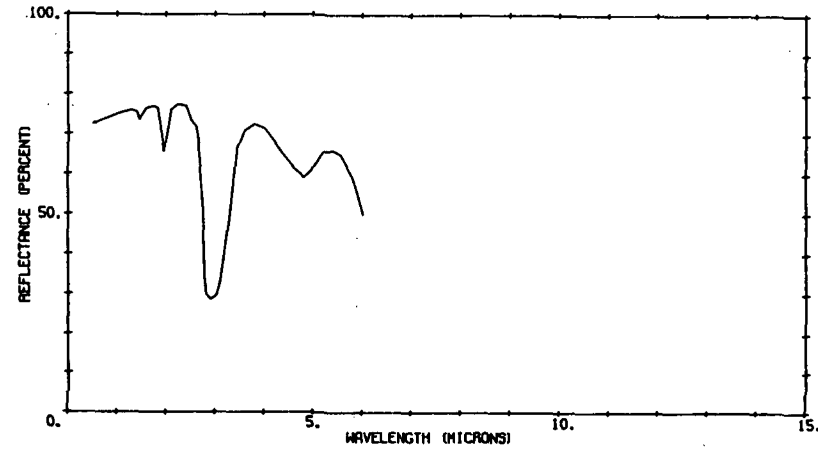
B02131 061

ALUMINA (SAPHIRE)--SHEET.



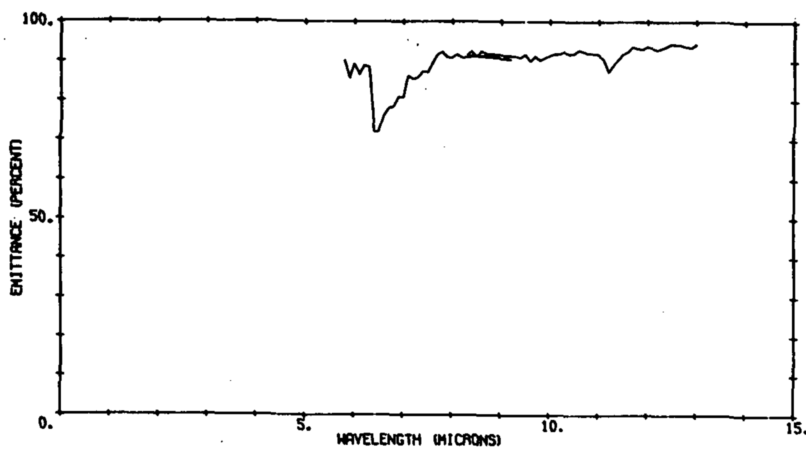
B04804 006

SODIUM CHLORIDE.



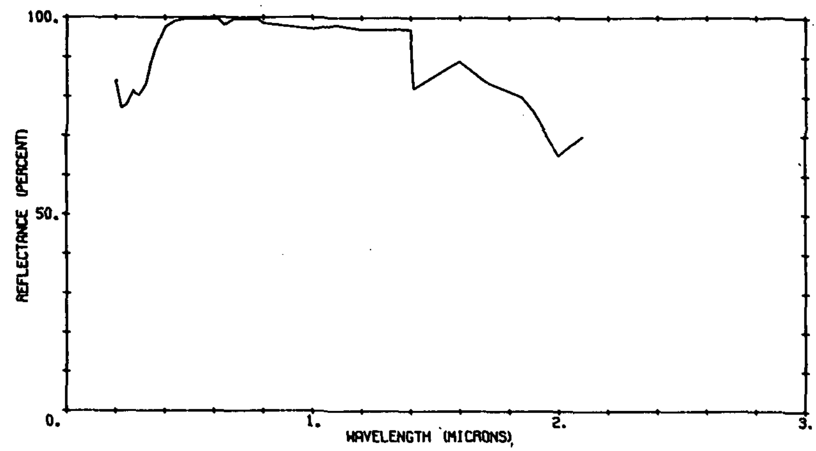
B02131 063

ROUGHENED DOLOMITE ROCK.



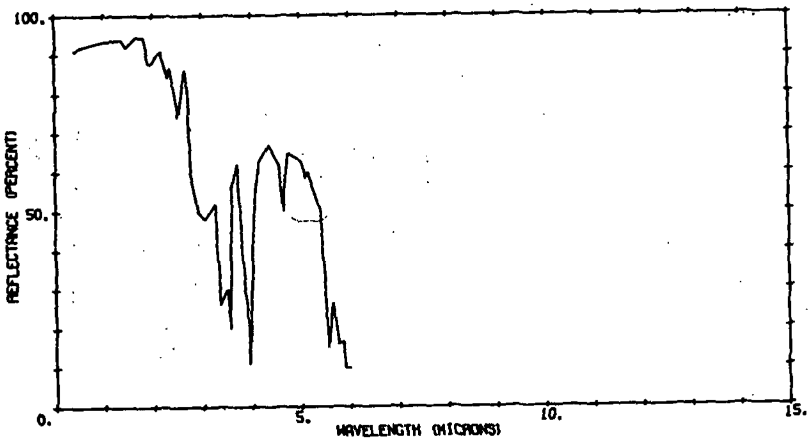
B14004 001

MAGNESIUM CARBONATE WORKING STANDARD CALIBRATION



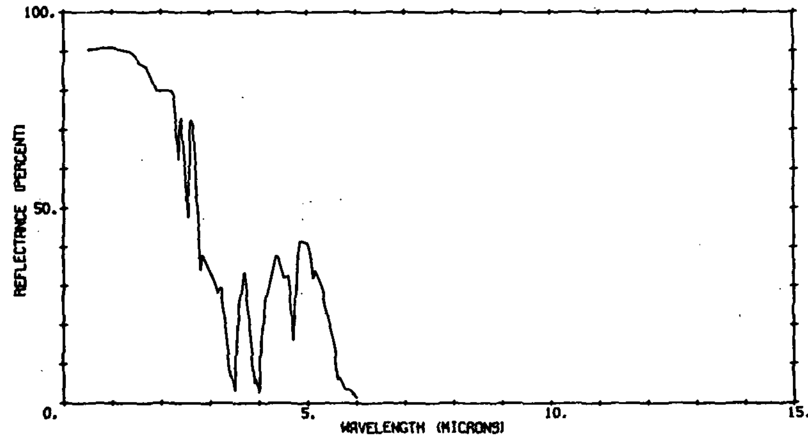
B04804 001

CALCIUM CARBONATE.



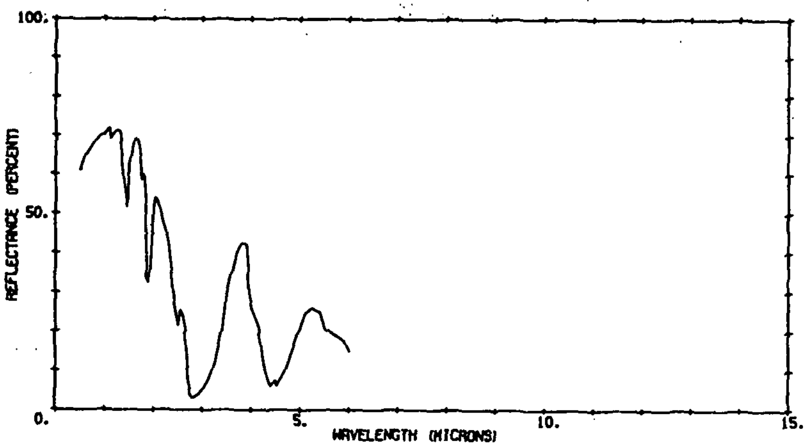
B04804 002

SODIUM CARBONATE.



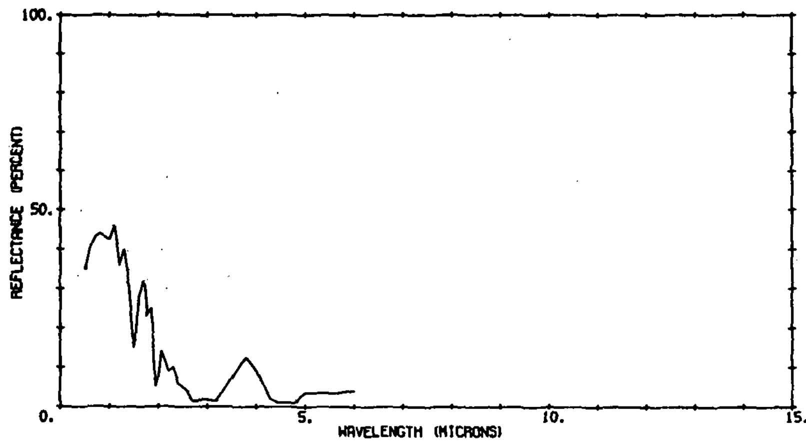
B04804 010

GYPSUM SAND, PARTIALLY DEHYDRATED.



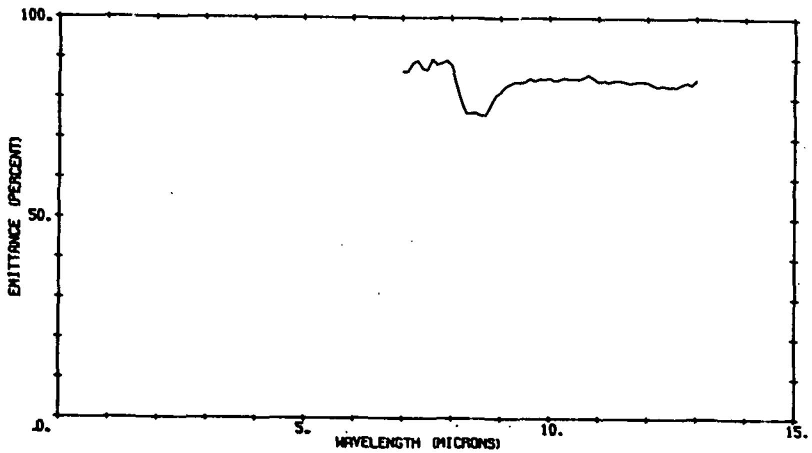
B04804 011

GYPSUM SAND, NATURAL.



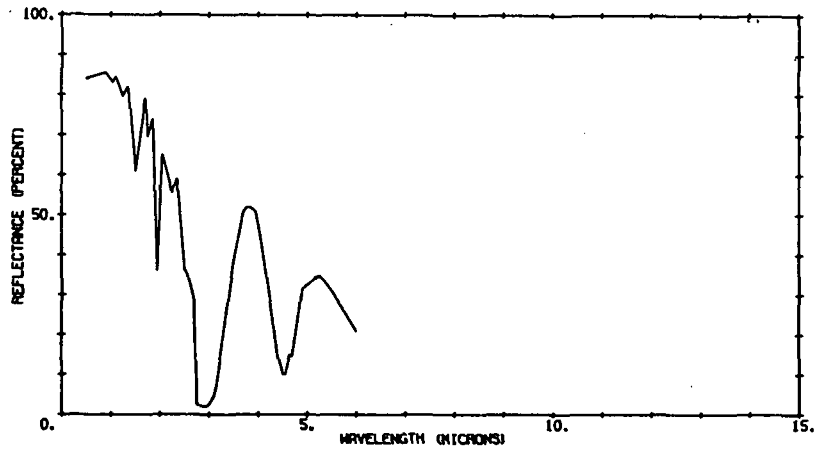
R02131 062

ANHYDRITE SAND.



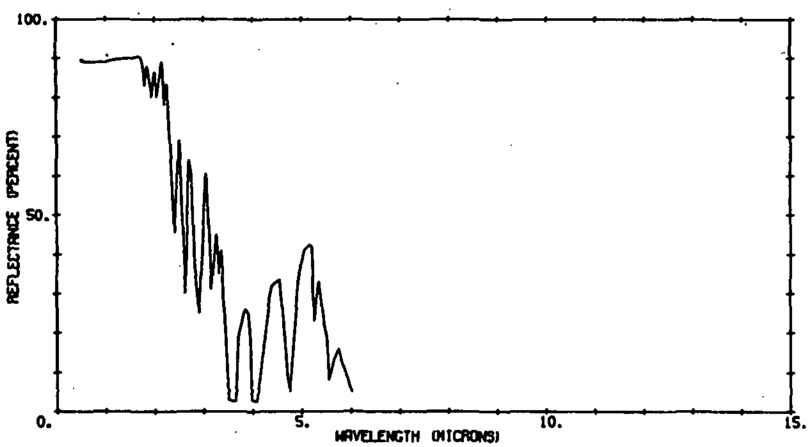
B04804 003

HYDROUS CALCIUM SULFATE.



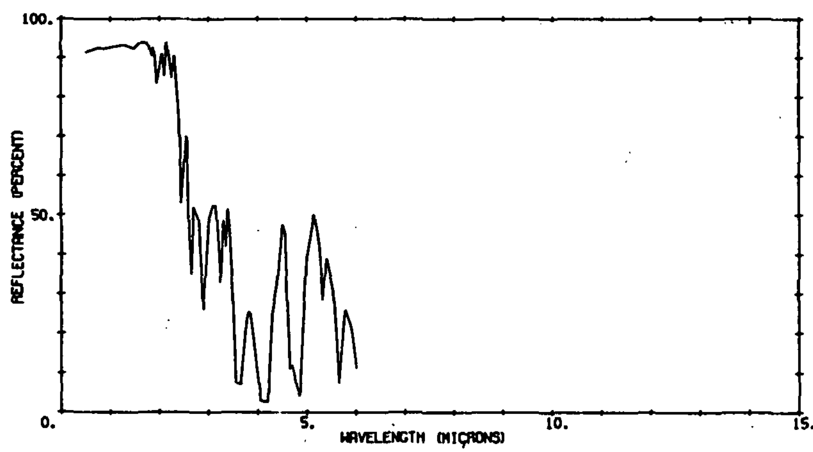
B04804 004

SODIUM NITRATE.



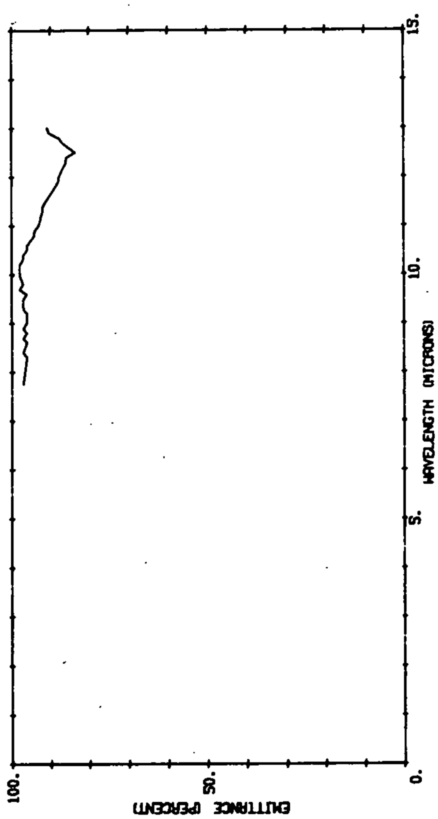
B04804 005

POTASSIUM NITRATE.



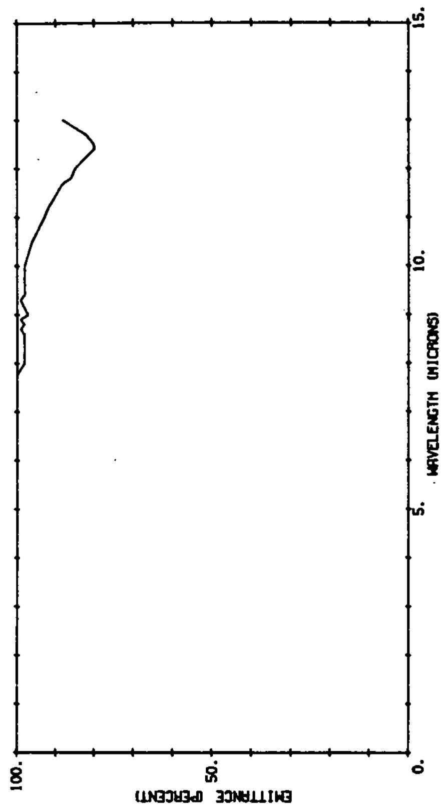
B02131 053

SILICON CARBIDE (CARBORUNDUM)--12 MICRONS.



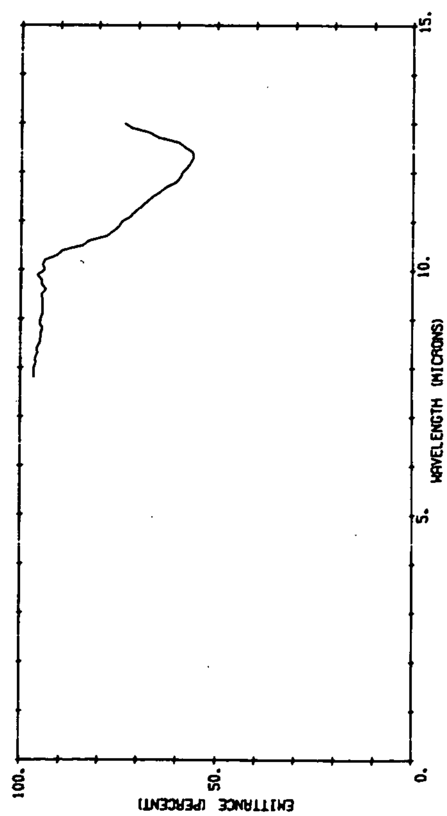
B02131 054

SILICON CARBIDE (CARBORUNDUM)--17 MICRONS.



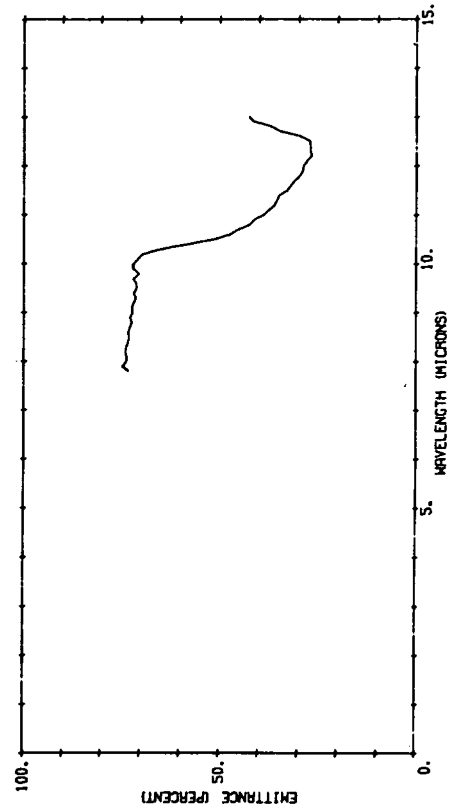
B02131 055

SILICON CARBIDE (CARBORUNDUM)--75 TO 150 MICRONS.



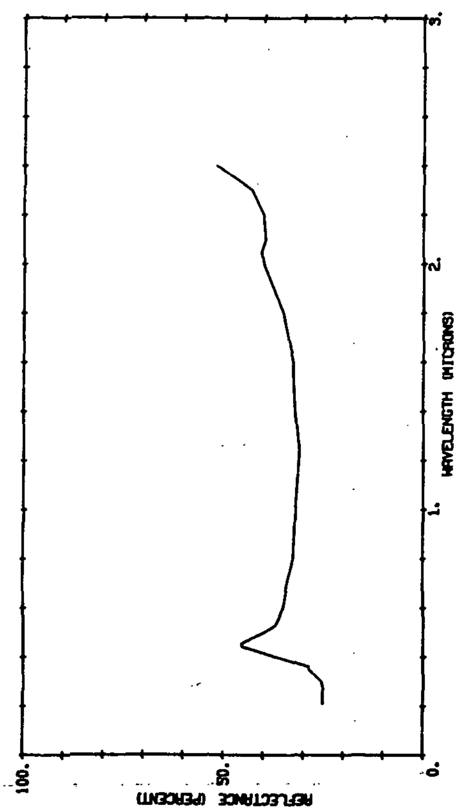
B02131 056

SILICON CARBIDE (CARBORUNDUM)--SOLID.



814004 092

GRAPHITE



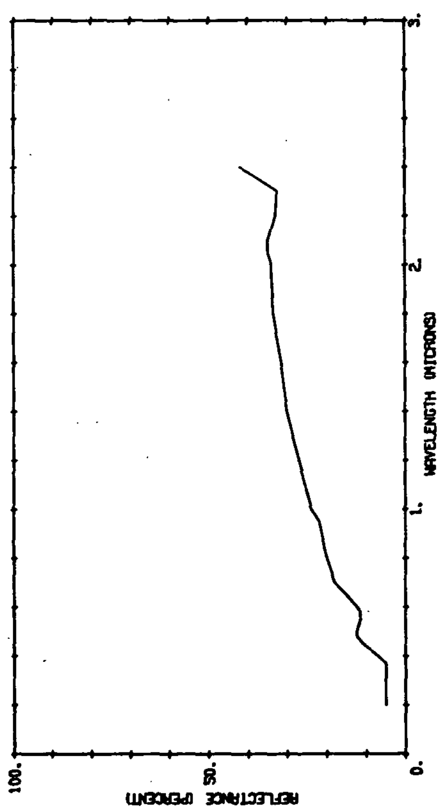
130

ORES AND HYDROTHERMALLY ALTERED ROCK

188

B14004 096

FLINT



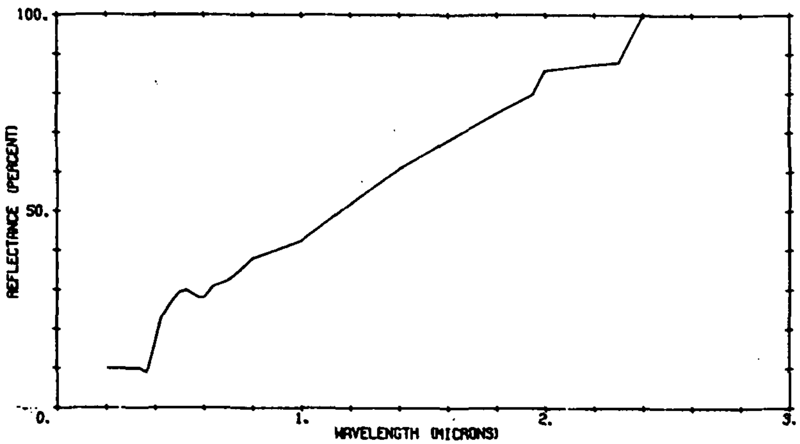
131

ORES AND HYDROTHERMALLY ALTERED ROCK

Ores

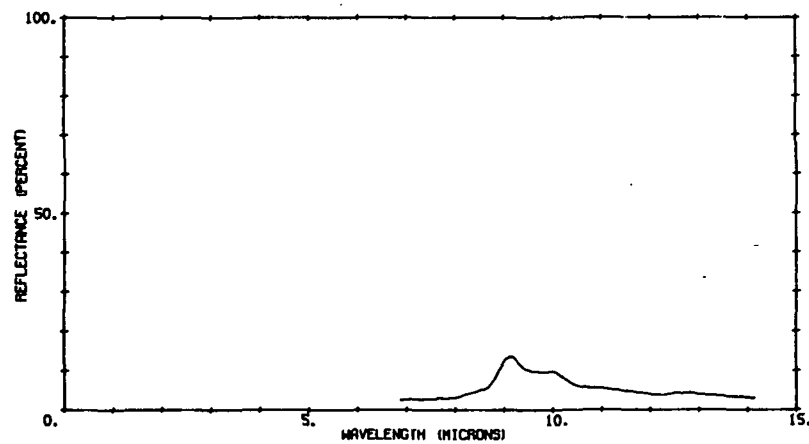
B14004 085

URANIUM ORE



B07139 001

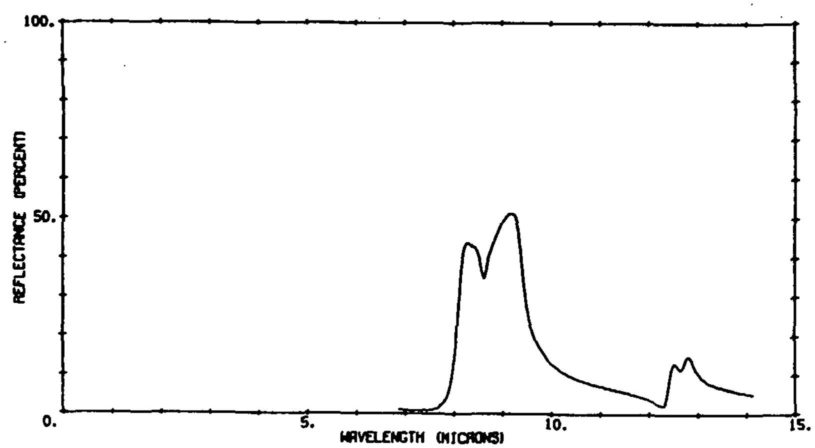
MINERALIZED VEIN MATERIAL FROM COCOMONGO MINE,
WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



191

B07139 002

MINERALIZED VEIN MATERIAL FROM COCOMONGO MINE,
FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



132

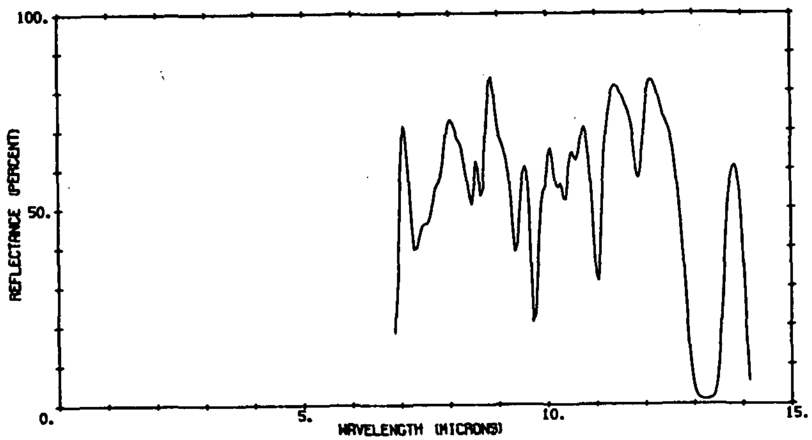
ORES AND HYDROTHERMALLY ALTERED ROCK

Hydrothermally Altered Rock

192

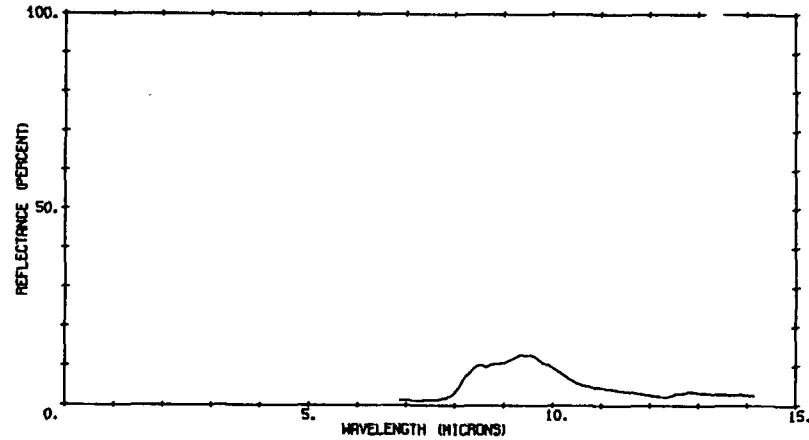
B07139 009

BONANZA LATITE (HYDROTHERMALLY ALTERED),
WEATHERED SURFACE.
VIEWING ANGLE = 15 DEG.



B07139 010

BONANZA LATITE (HYDROTHERMALLY ALTERED),
FRESH SURFACE.
VIEWING ANGLE = 15 DEG.



141

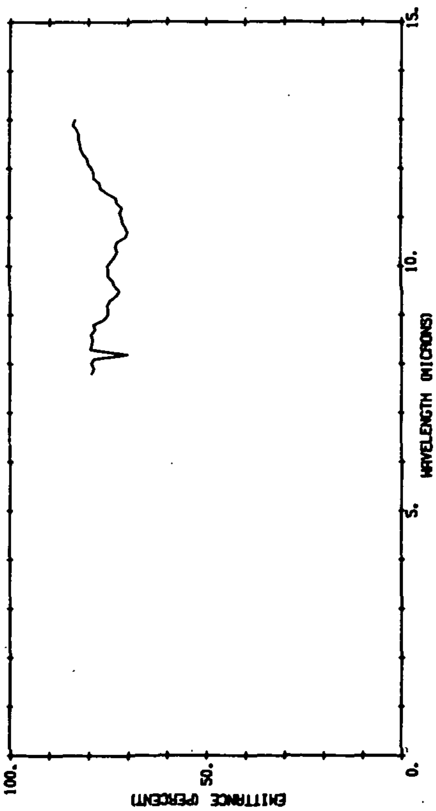
METEORITES

Chondrites

194

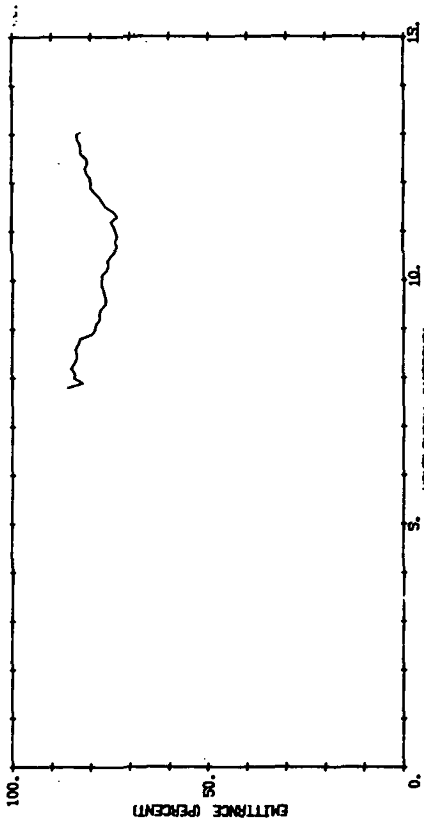
B02131 048

LEEDY CHONDRITE--METEORITIC MATERIAL.



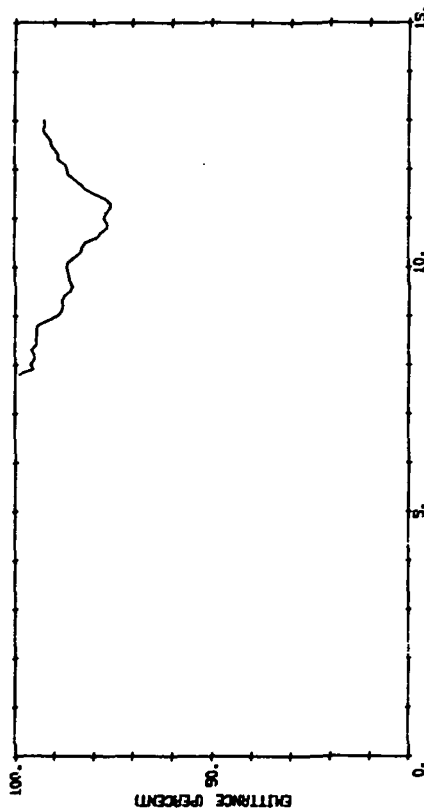
B02131 049

LEEDY CHONDRITE--METEORITIC MATERIAL.



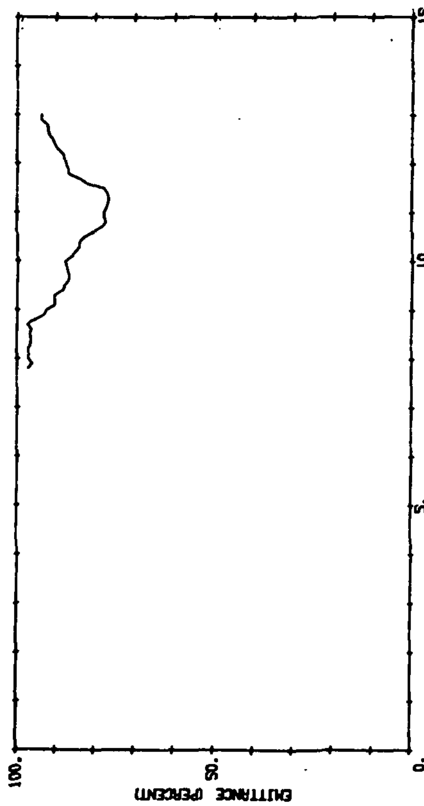
B02131 050

FARMINGTON CHONDRITE SAMPLE--SIDE 1.



B02131 051

FARMINGTON CHONDRITE SAMPLE--SIDE 2.



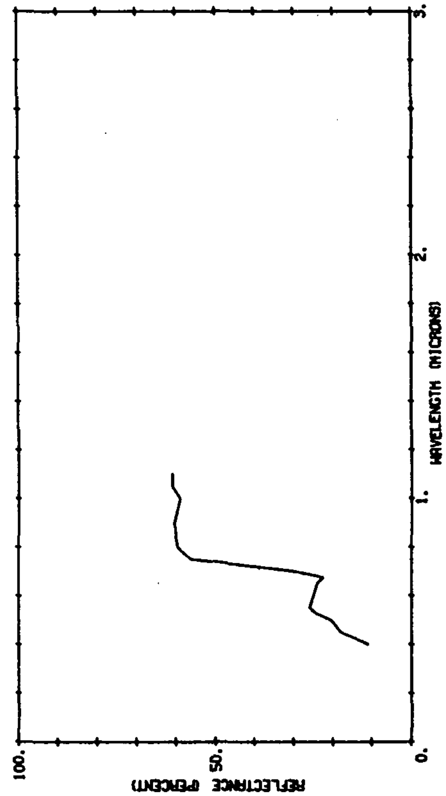
BE

TERRAIN UNIFORMITY

196

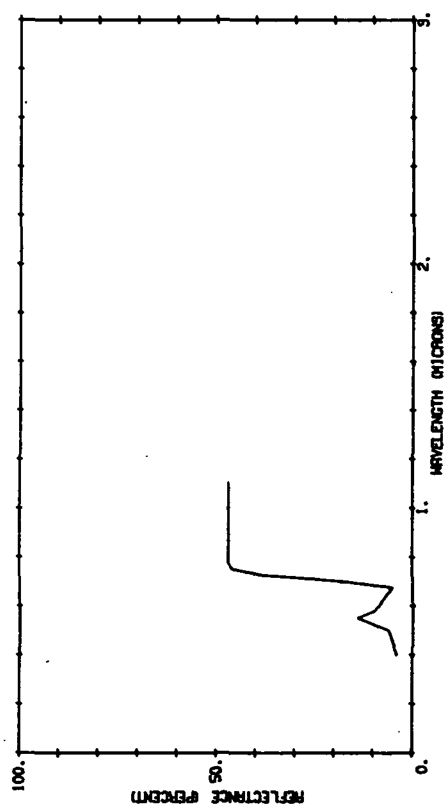
B01049 022

DESERT



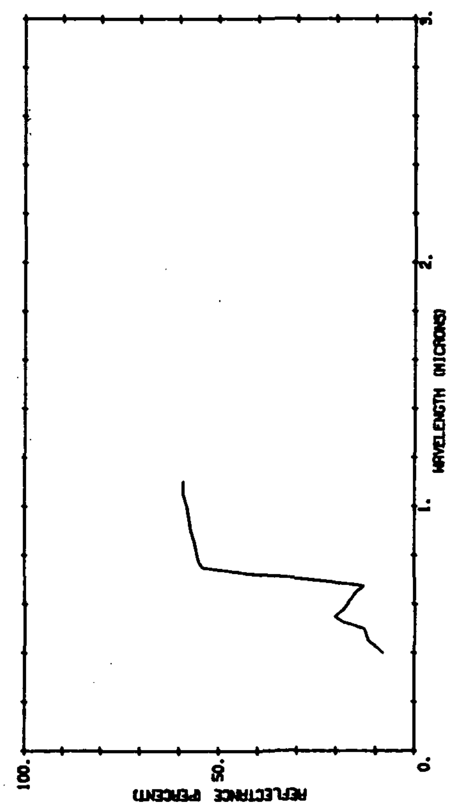
B01049 021

CAMPUS, SHADED



B01049 025

SUBALPINE SLOPE, OPEN

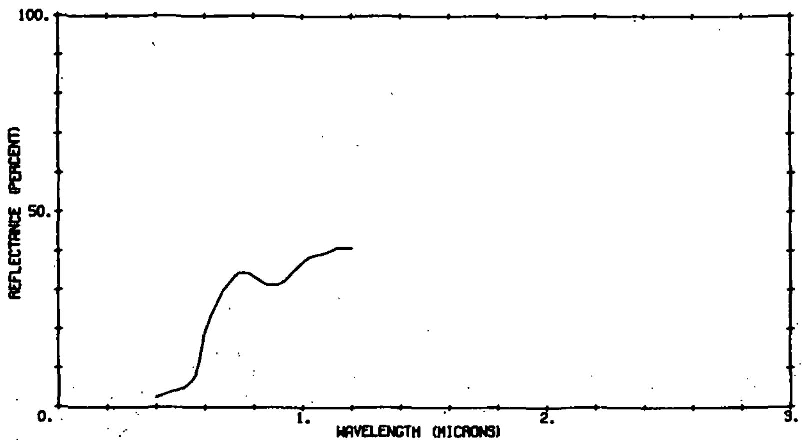


BF
SOIL

198

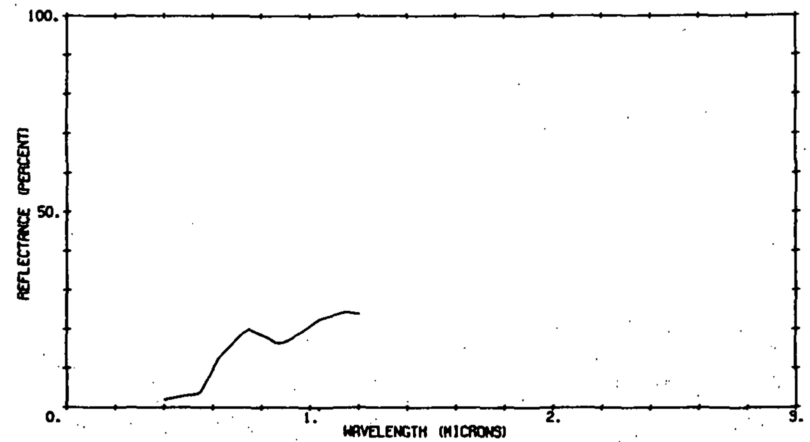
B00830 006

PONTA GROSSA, BRAZIL, DRY



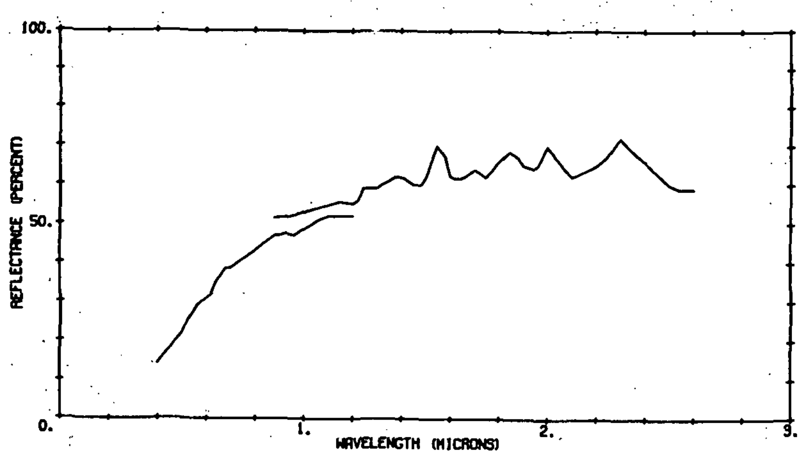
B00830 008

PONTA GROSSA, BRAZIL, WET



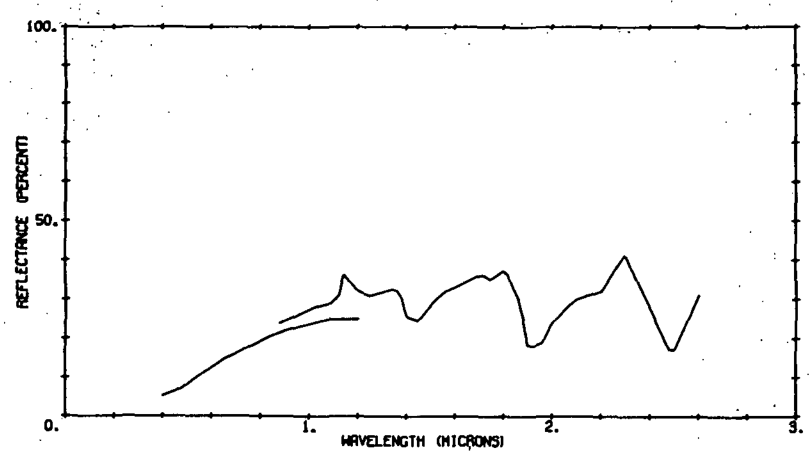
B00830 009

DRY SOIL, TYPE UNKNOWN



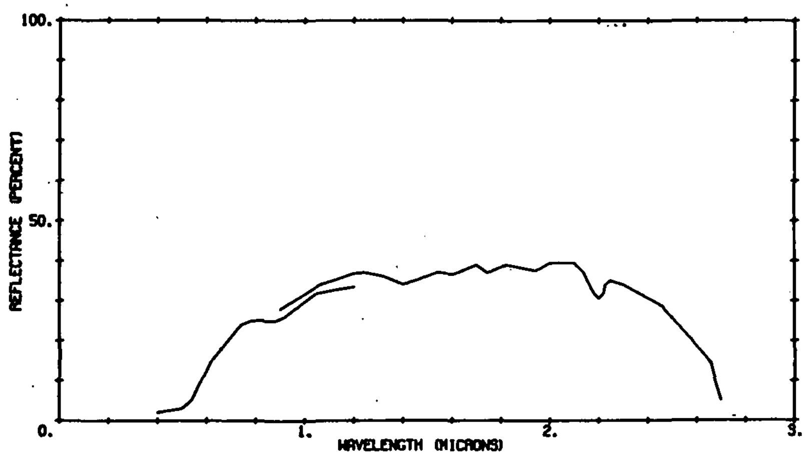
B00830 011

WET SOIL, TYPE UNKNOWN



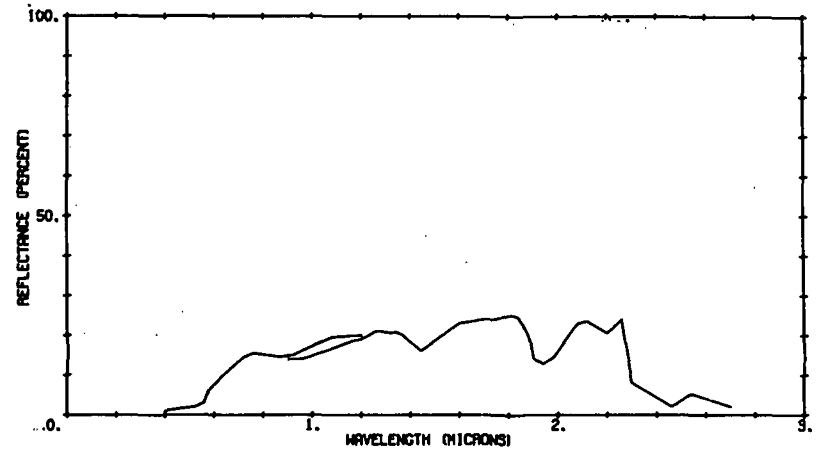
B00830 013

COFFEE FARM, DRY, KIAMBU, AFRICA



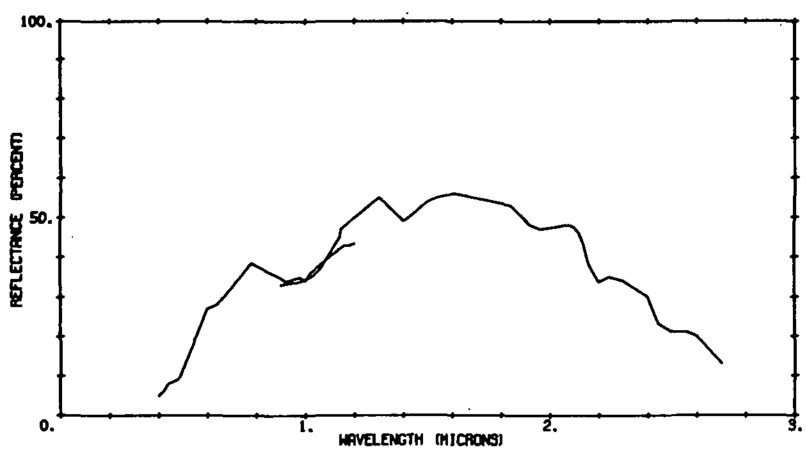
B00830 015

COFFEE FARM, WET, KIAMBU, AFRICA



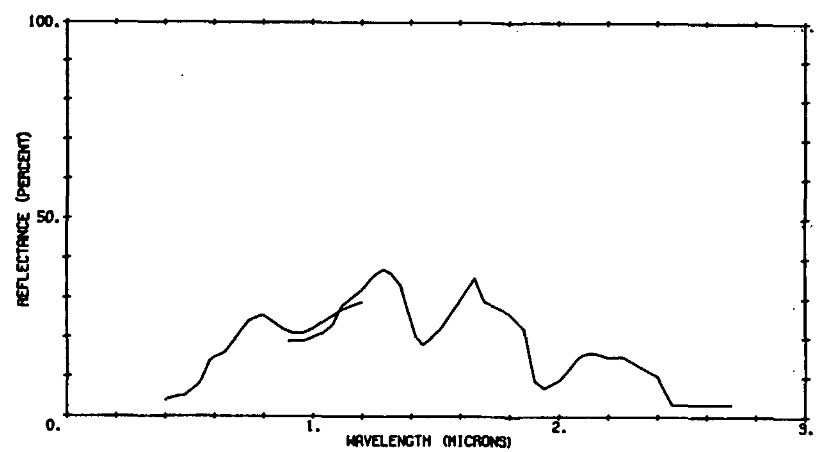
B00830 045

SOIL TYPE NO. 15, DRAH BUSH, LIBERIA, AFRICA, WET



B00830 047

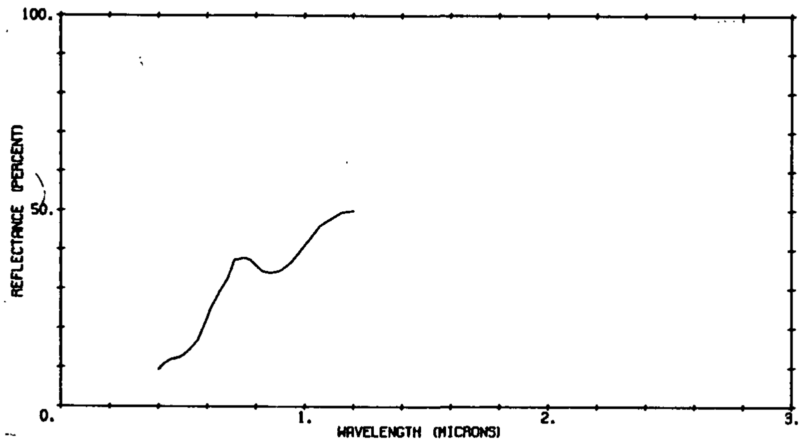
SOIL TYPE NO. 15, DRAH BUSH, LIBERIA, AFRICA, WET



BF 2

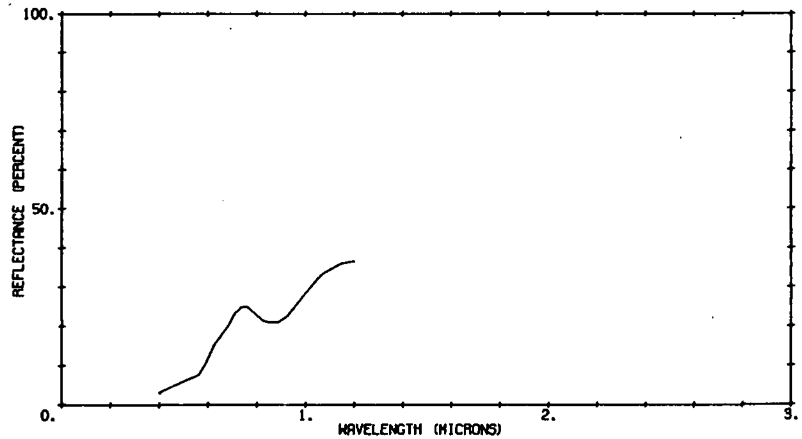
B00830 065

SOIL, TYPE NO. 28, BIABA SUKI, LIBERIA, W. A., DRY



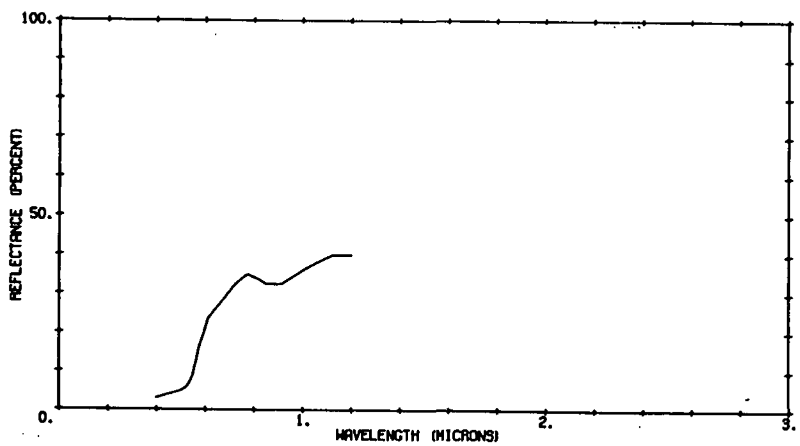
B00830 067

SOIL, TYPE NO. 28, BIABA SUKI, LIBERIA, W.A., WET



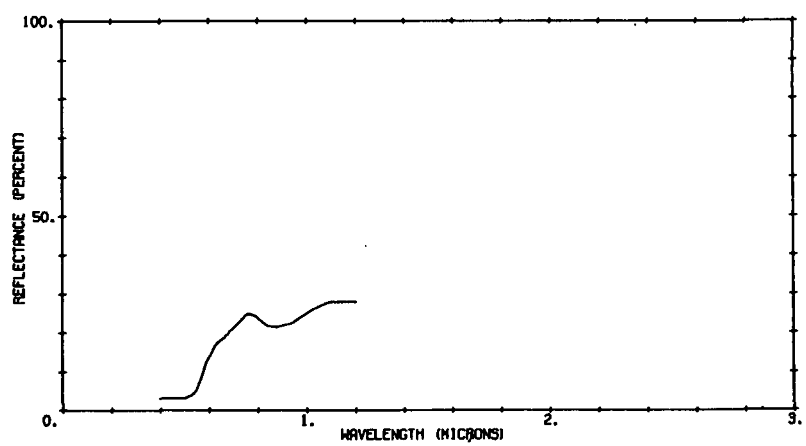
B00830 094

SOIL, BOITUVA, SOROCABANA RY, BRAZIL, DRY



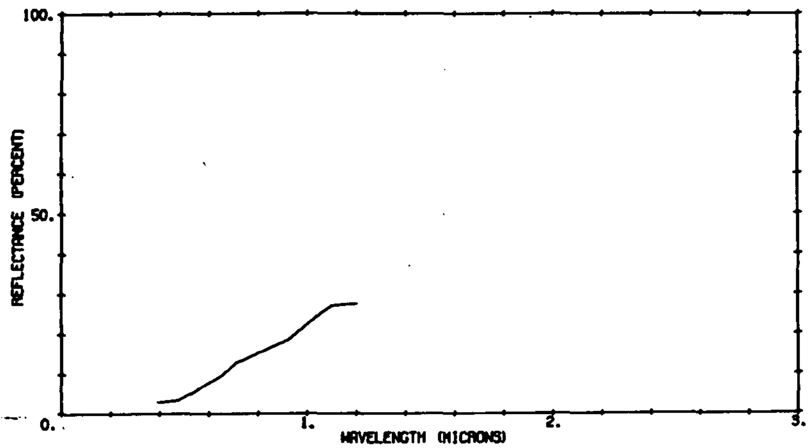
B00830 096

SOIL, BOITUVA, SOROCABANA RY, BRAZIL, WET



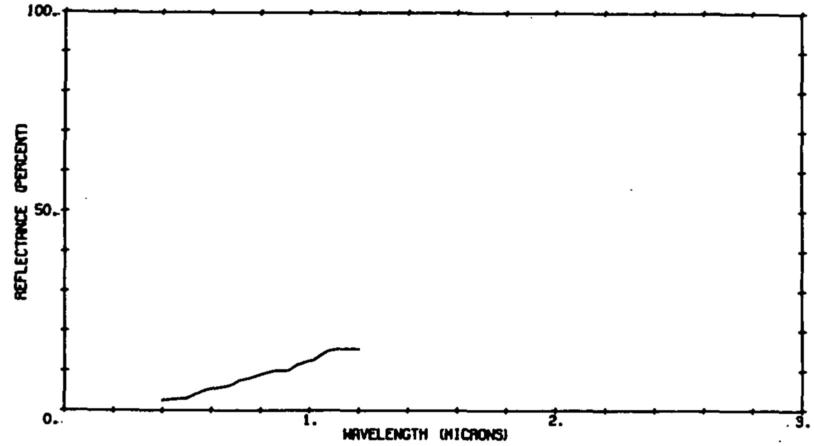
B00830 135

SOIL, CASHOEIRA-ARVAM, BRAZIL, S.A., DRY



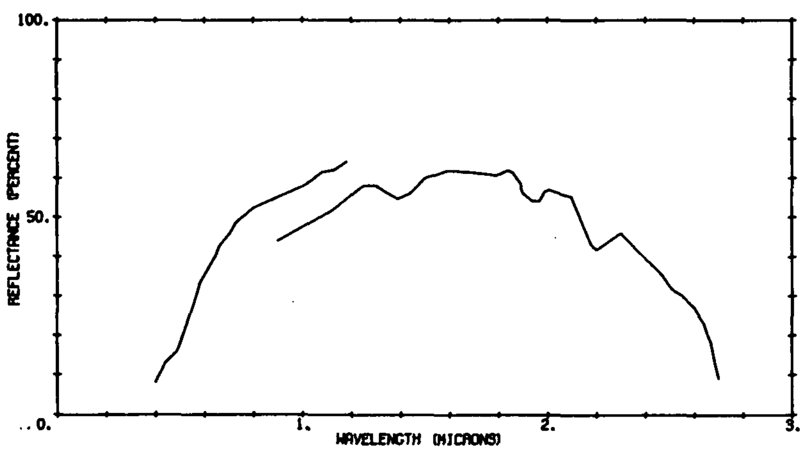
B00830 136

SOIL, CASHOEIRA-ARVAM, BRAZIL, S.A., WET



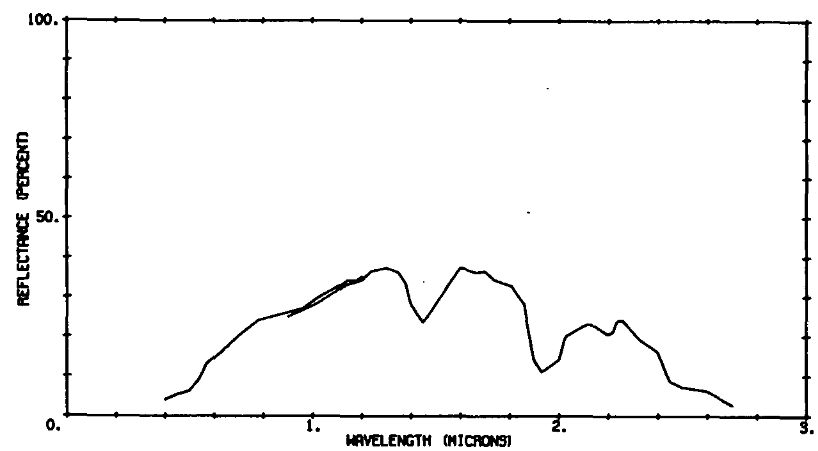
B00830 155

PLATEAU, NYASALAND, AFRICA, DRY



B00830 157

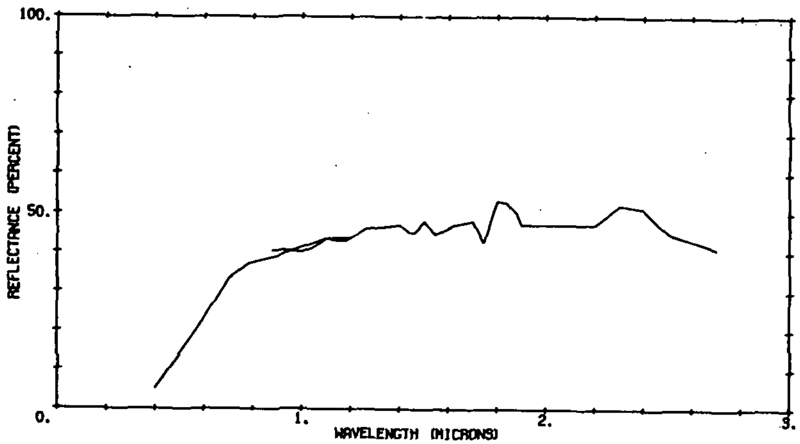
PLATEAU, NYASALAND, AFRICA, WET



BF 4

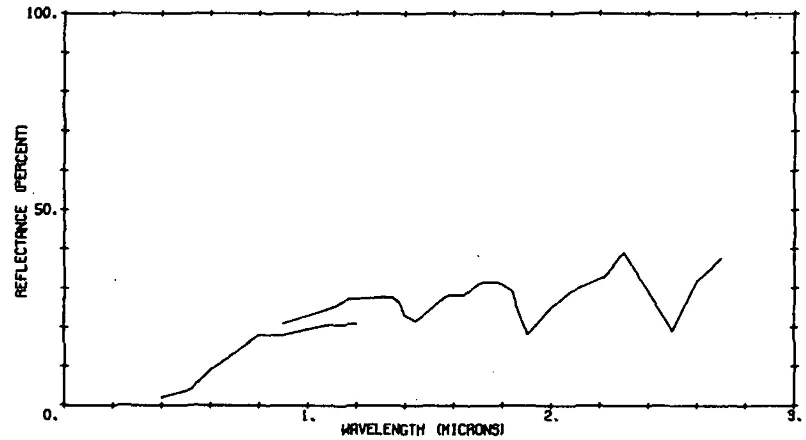
B00830 171

DRY SOIL, TYPE UNKNOWN



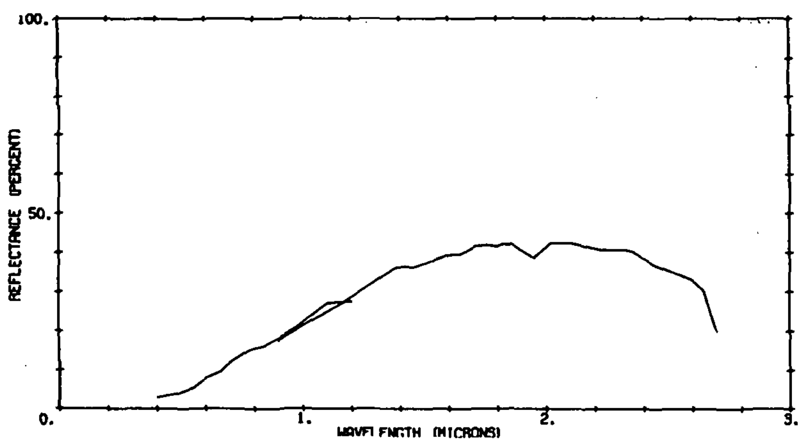
B00830 173

WET SOIL, TYPE UNKNOWN



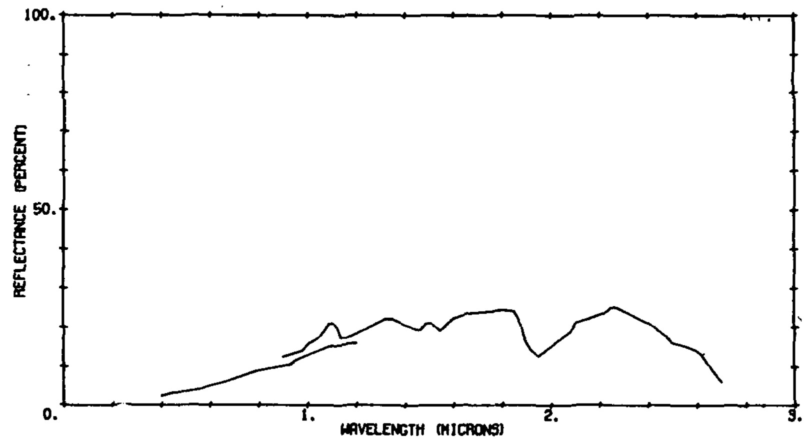
B00830 175

SOIL, CASHOEIRA-AKVAM, BRAZIL, S.A., DRY



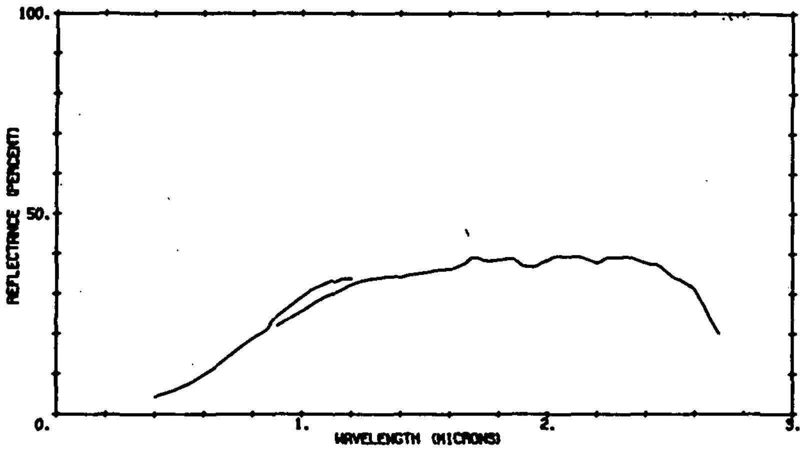
B00830 177

SOIL, CASHOEIRA-ARVAM, BRAZIL, S.A., WET



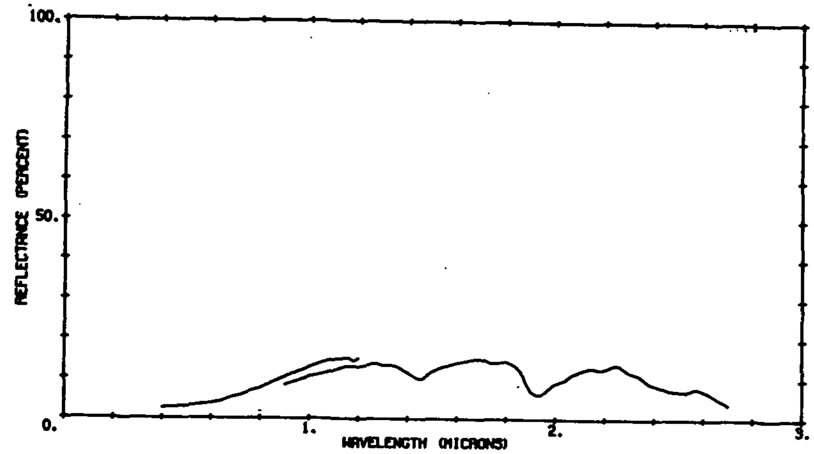
B00830 187

SOIL, LAS FLORES, ARGENTINA, DRY



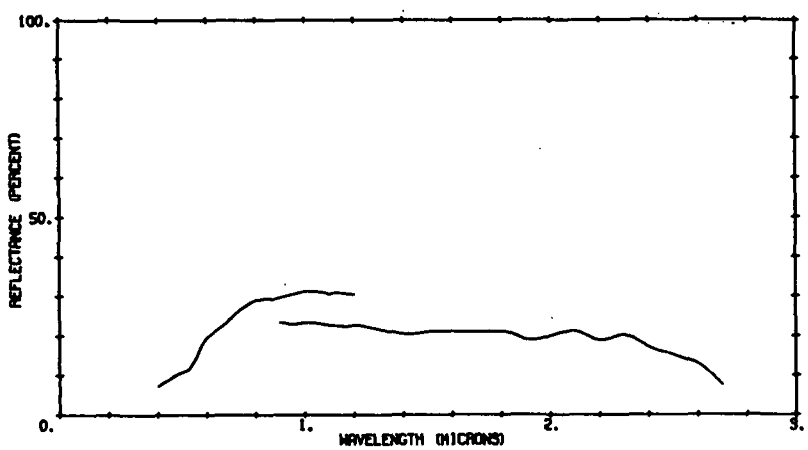
B00830 189

SOIL, LAS FLORES, ARGENTINA, WET



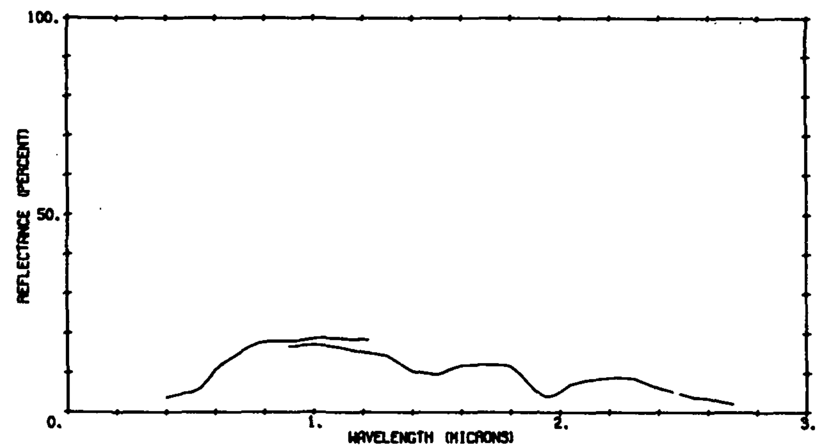
B00830 195

LAND, ROUGH AND BROKEN, COLORADO, DRY



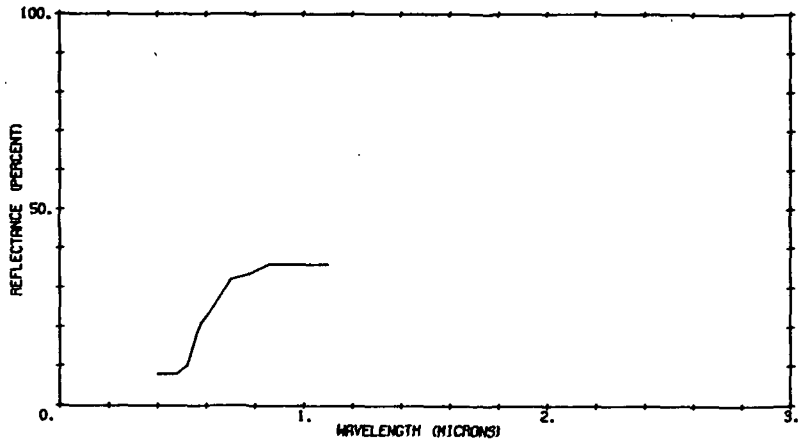
B00830 197

LAND, ROUGH AND BROKEN, COLORADO, WET



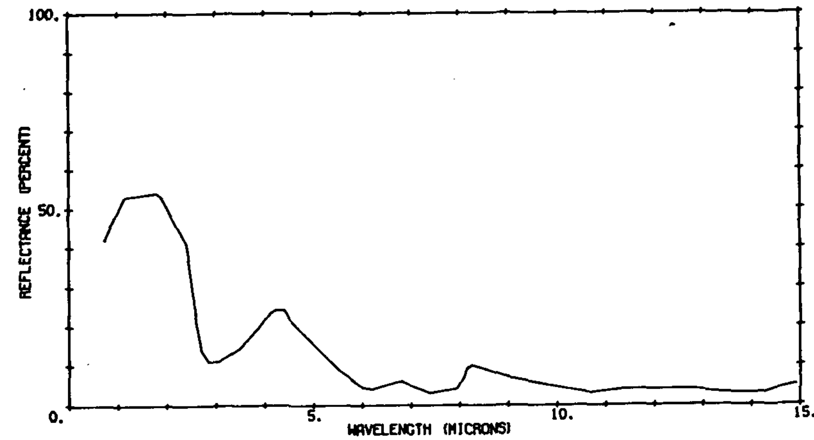
B01176 047

RED EARTH, DRY



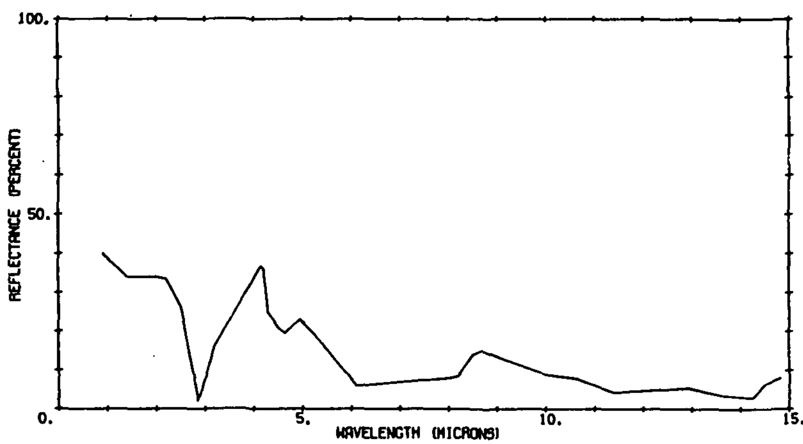
B01818 019

VEREENIGING, AFRICA, SOIL



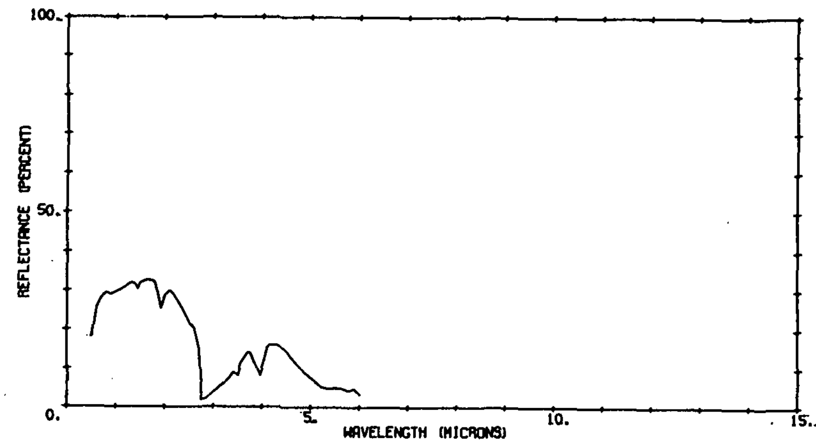
B01818 025

MESITA NEGRA-LOWER TEST SIGHT, SOIL



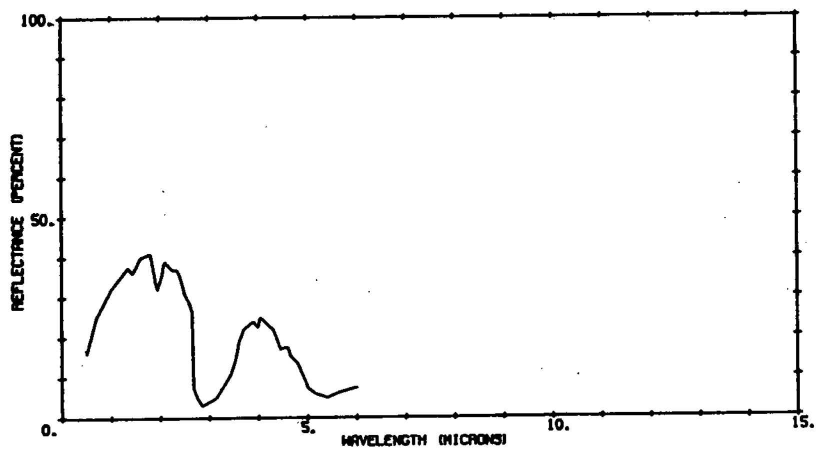
B04804 008

ROSAMOND DRY LAKE SOIL.



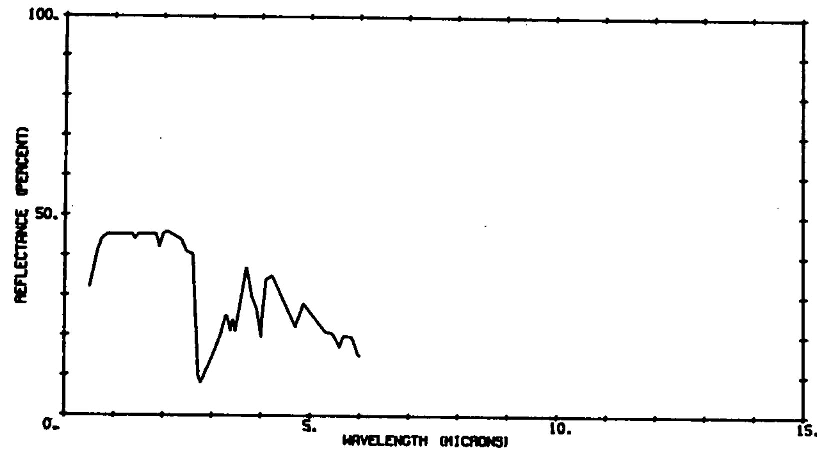
B04804 009

PAWNEE GRASSLAND SOIL.



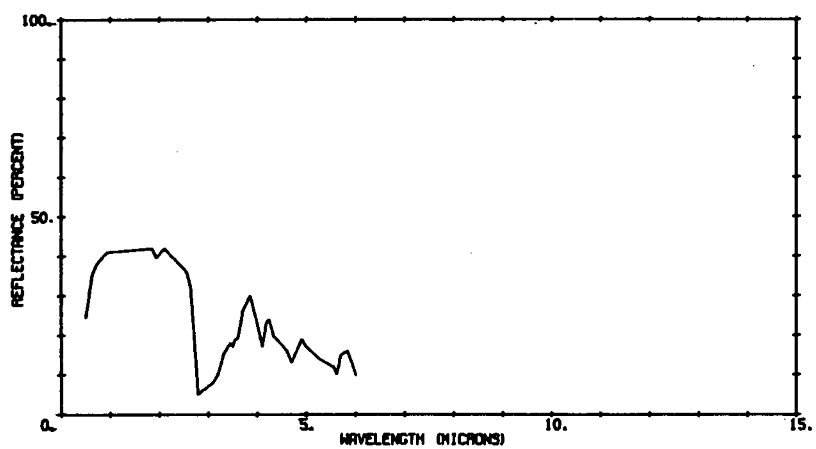
B04804 016

CHILEAN NITRATE SOIL, PAMPA, NEBRASKA.



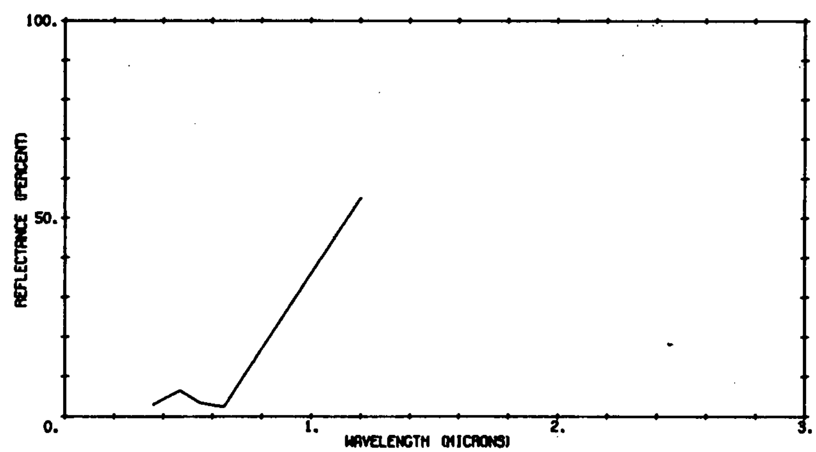
B04804 017

CHILEAN NITRATE SOIL, OFICINA, VICTORIA.



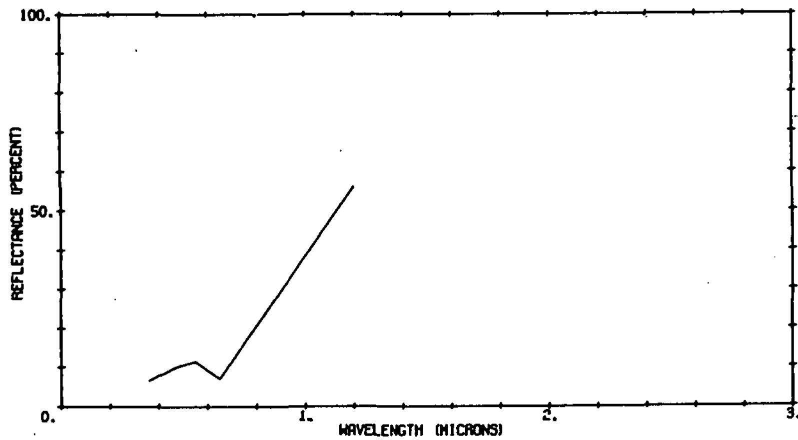
B13946 011

FINE DARK BROWN SOIL, DRY.



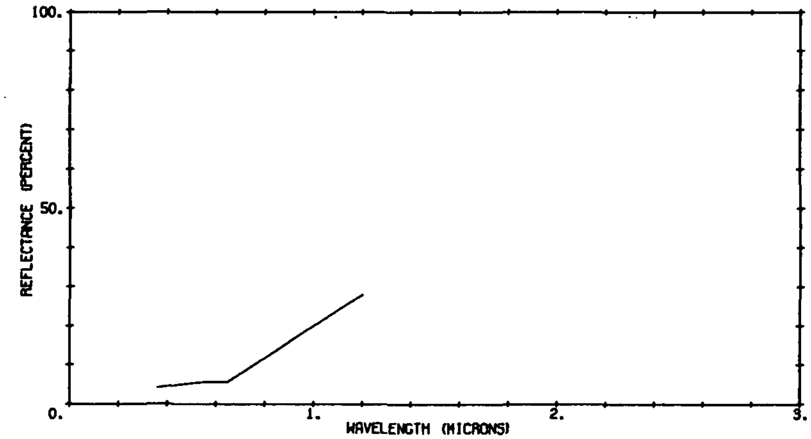
B13946 012

FINE GRAY SANDY SOIL, DRY.



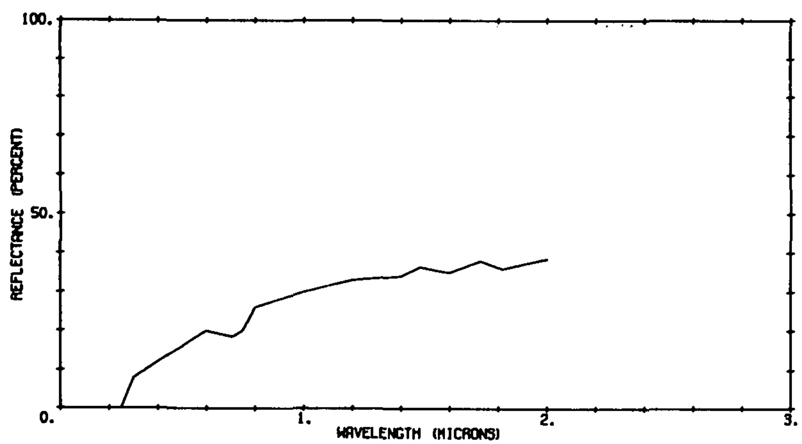
B13946 013

RICH BLACK SOIL, DRY.



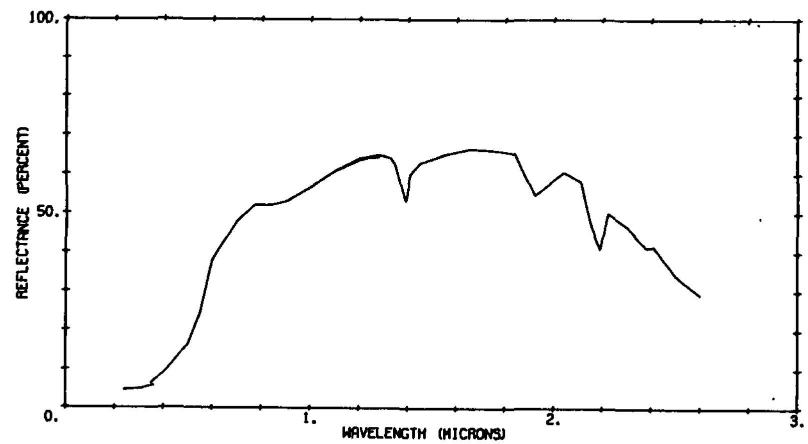
B13946 035

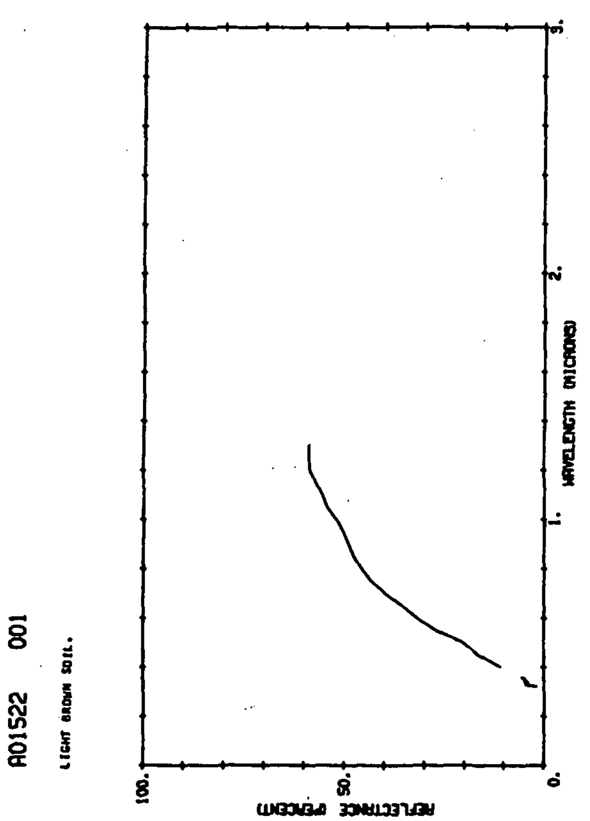
RED DESERT SOIL.



A01521 001

RED SOIL.

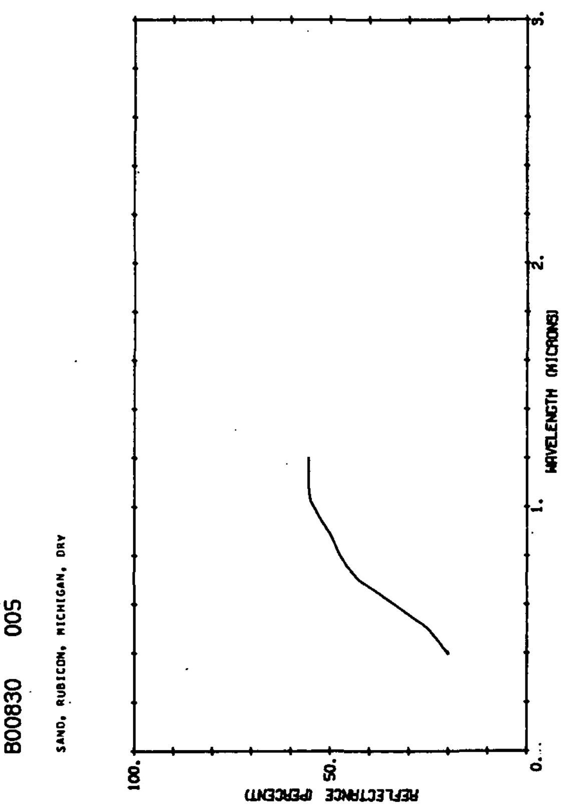


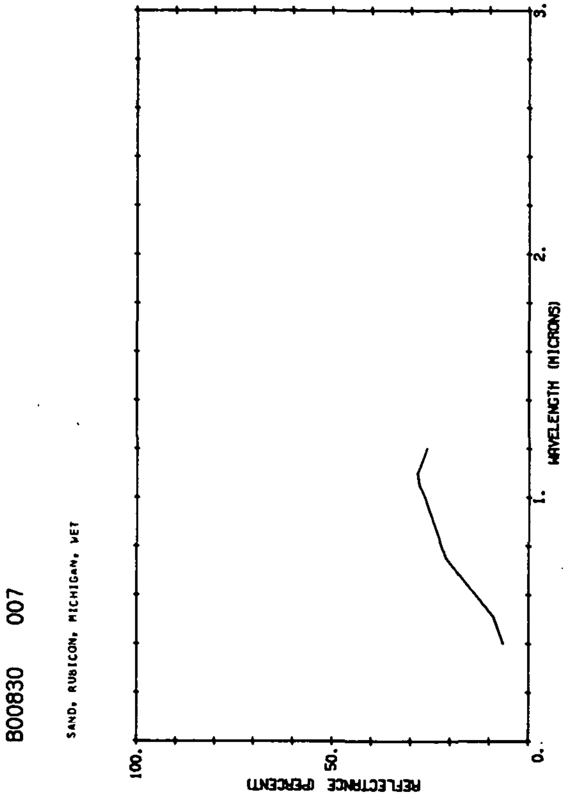

A01522 001
LIGHT BROWN SOIL.
REFLECTANCE (PERCENT)
0.
50.
100.
WAVELENGTH (MICRONS)
1.
2.
3.

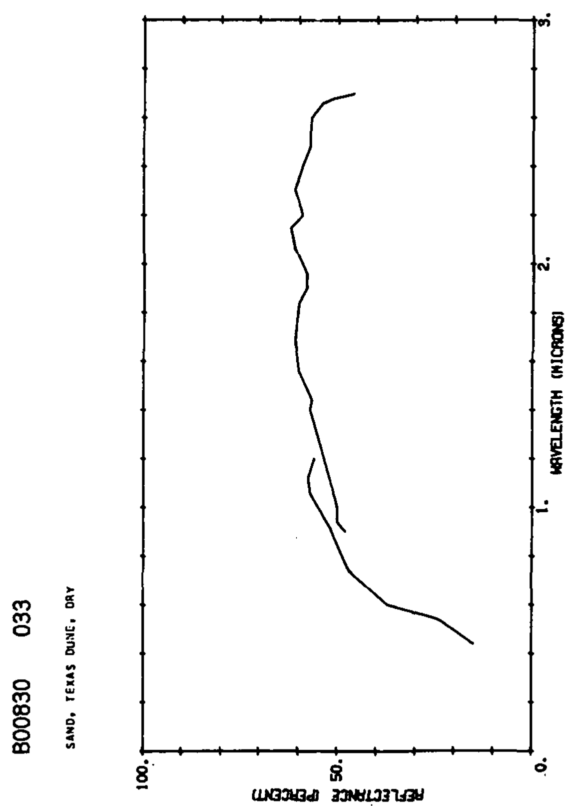
BFCA

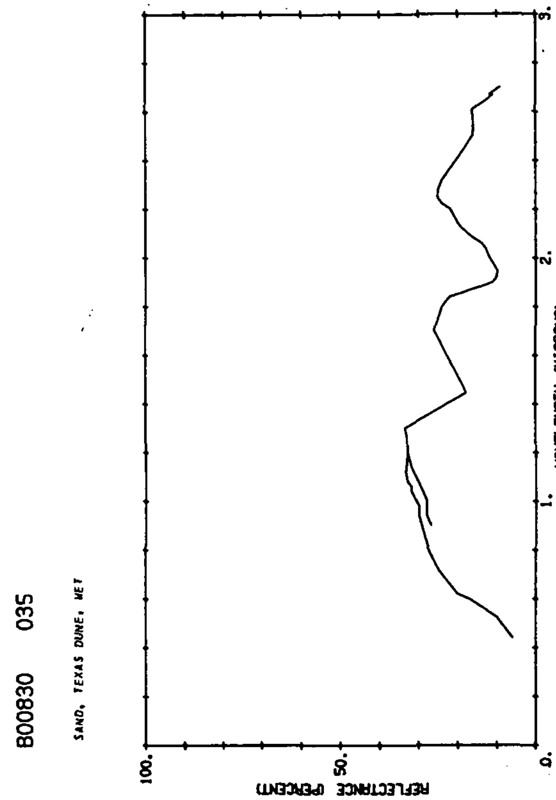
SOIL

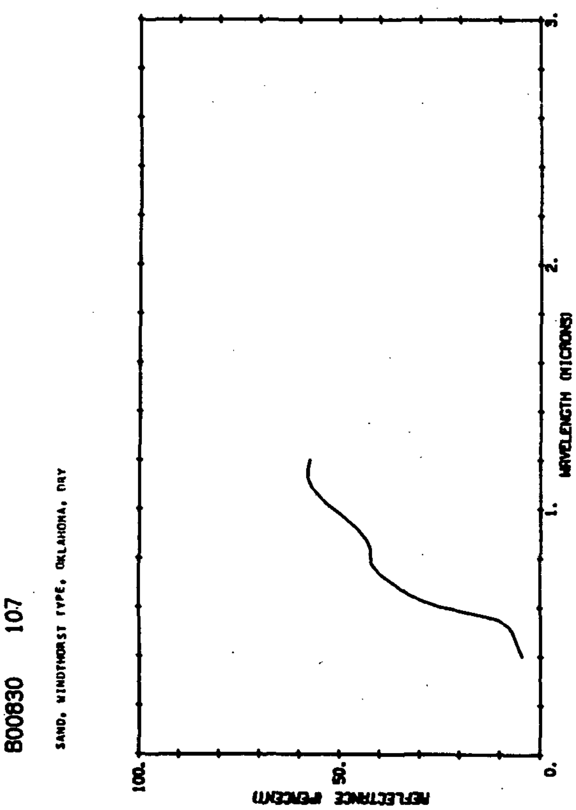
209

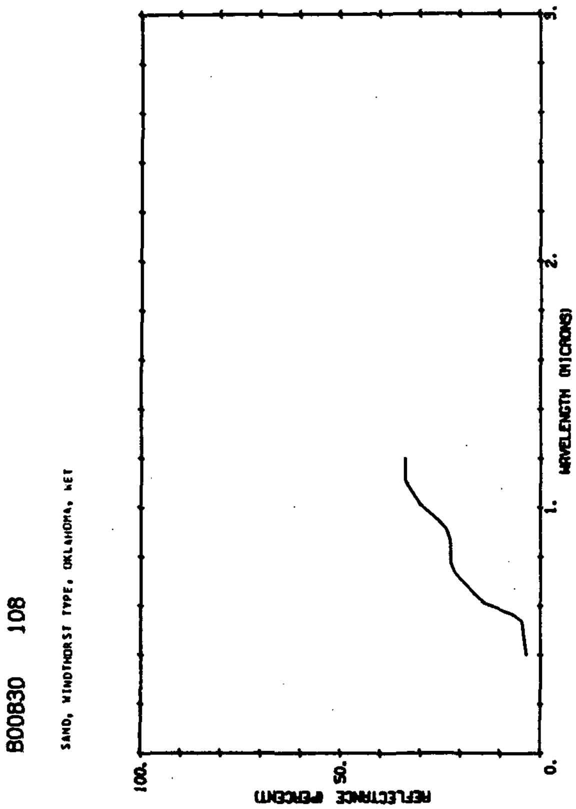

B00830 005
SAND, RUBICON, MICHIGAN, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

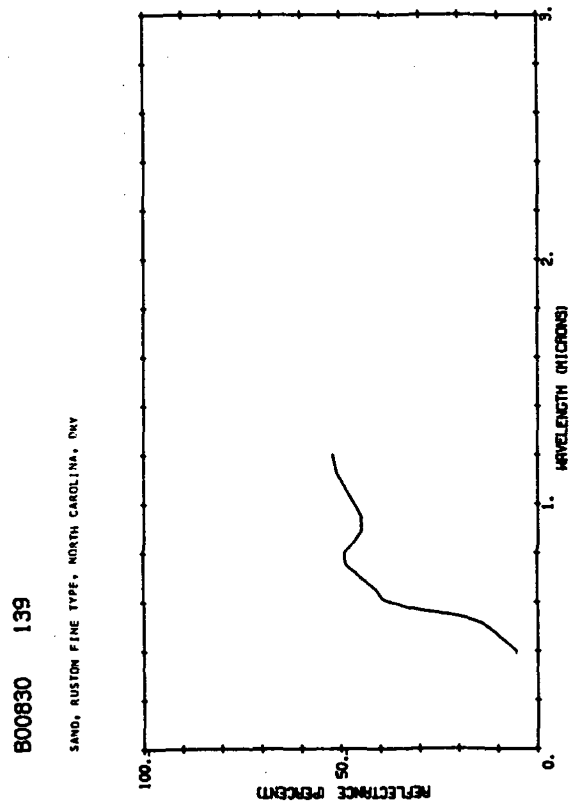

B00830 007
SAND, RUBICON, MICHIGAN, WET
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

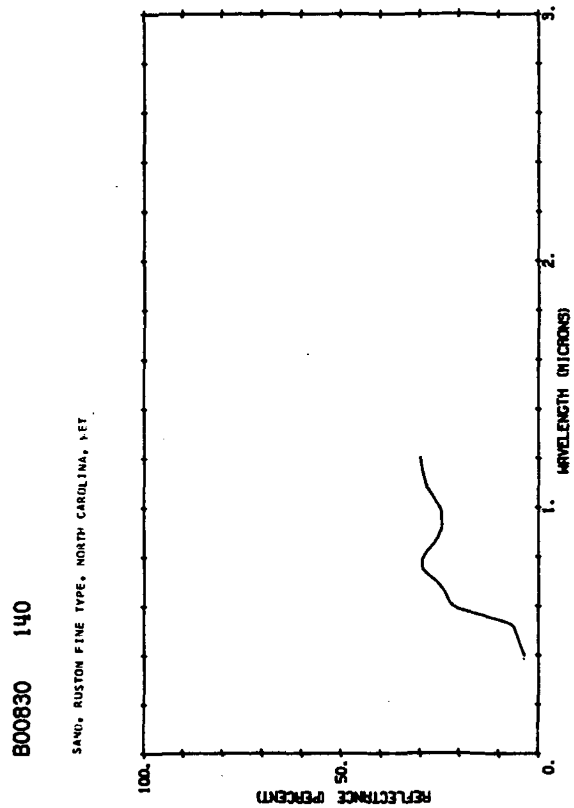

B00830 033
SAND, TEXAS DUNE, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B00830 035
SAND, TEXAS DUNE, WET
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B00830 107
SAND, WINDTHORST TYPE, OKLAHOMA, DRY
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

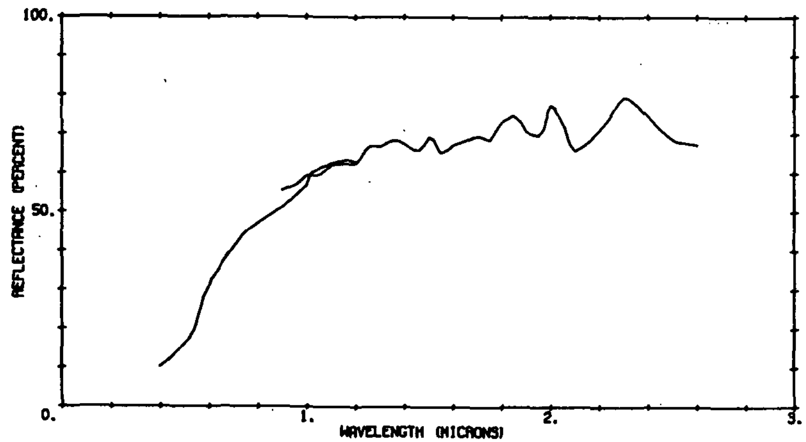

B00830 108
SAND, WINDTHORST TYPE, OKLAHOMA, WET
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.


B00830 139
SAND, RUSTON FINE TYPE, NORTH CAROLINA, DRY
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.


B00830 140
SAND, RUSTON FINE TYPE, NORTH CAROLINA, WET
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

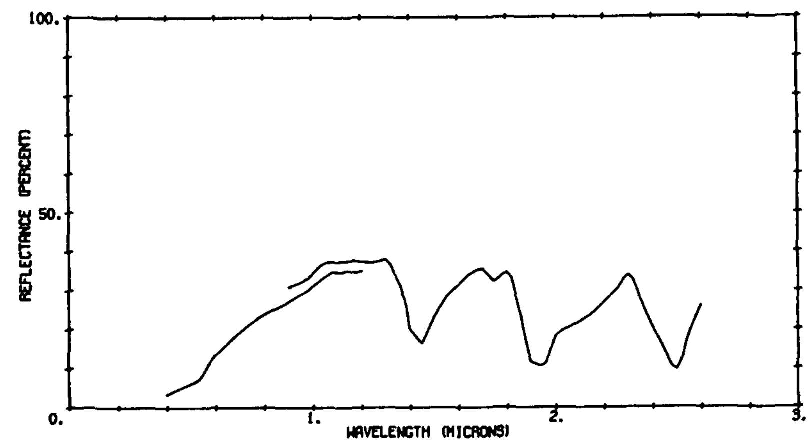
B00830 199

SAND, WINDTHORST TYPE, OKLAHOMA, DRY



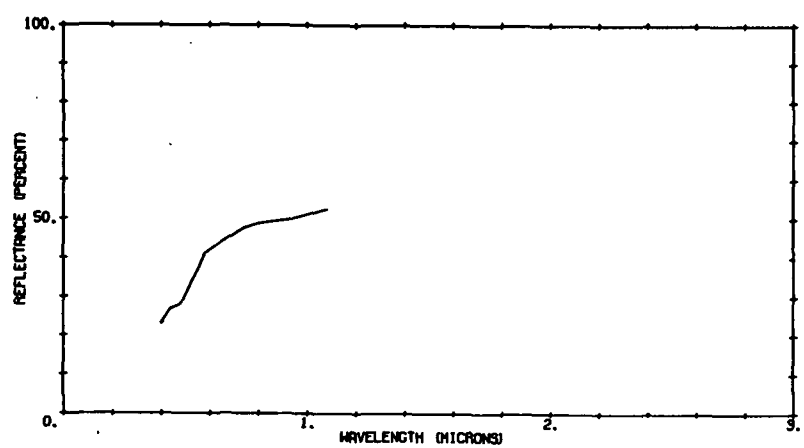
B00830 201

SAND, WINDTHORST TYPE, OKLAHOMA, WET



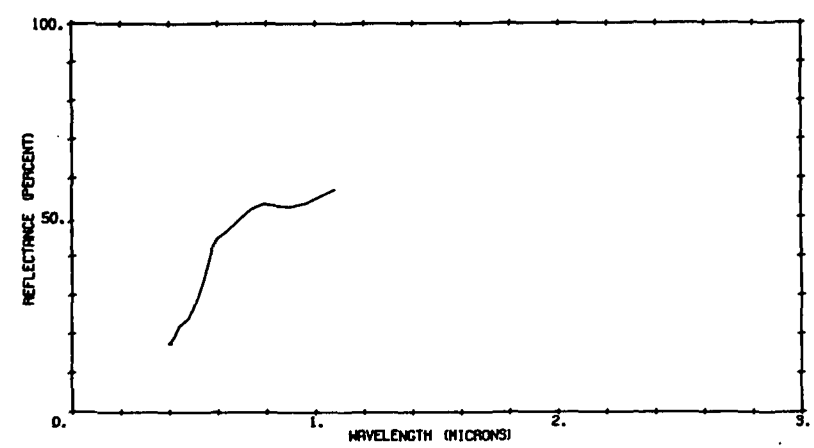
B01339 003

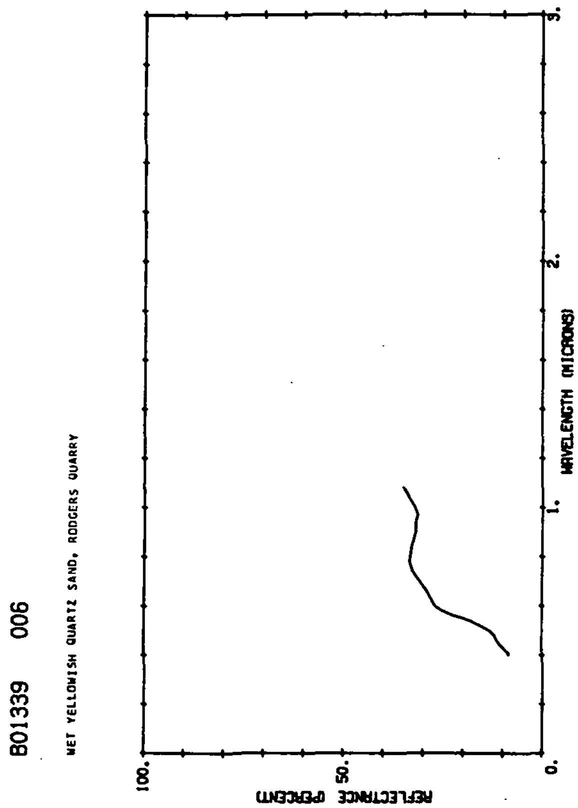
DRY WHITE SAND, RODGERS QUARRY

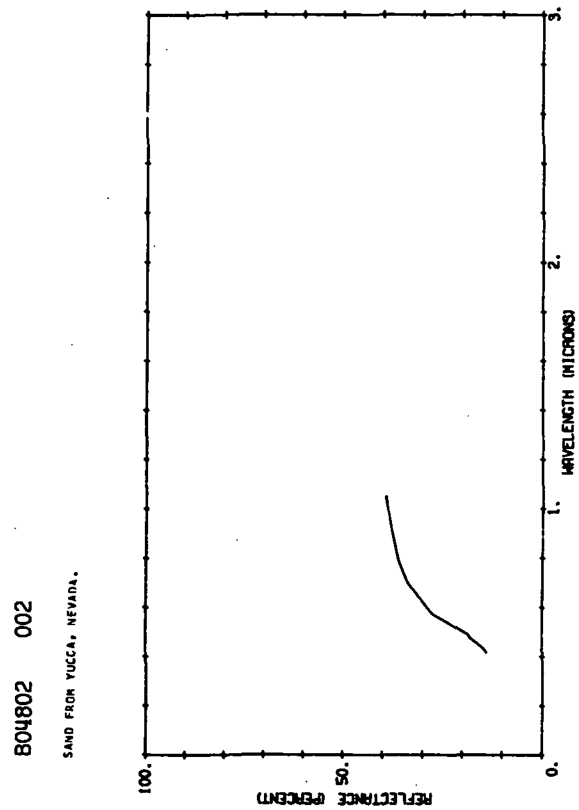


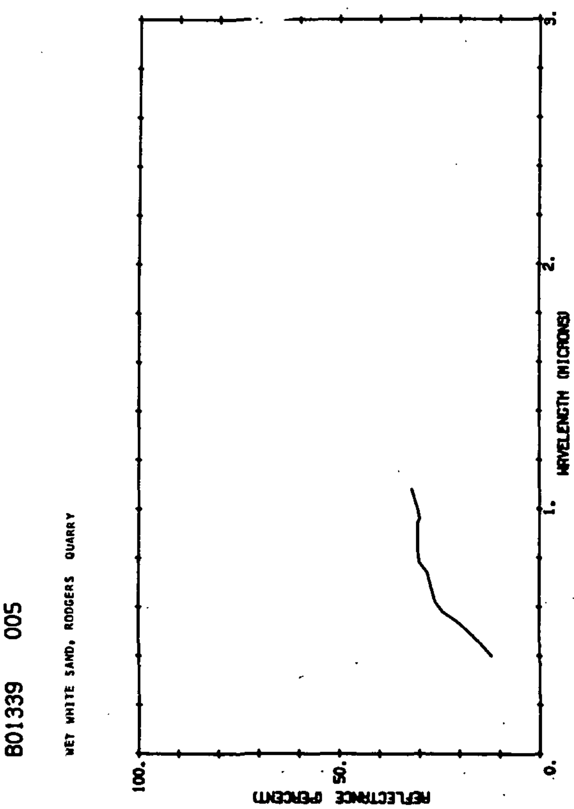
B01339 004

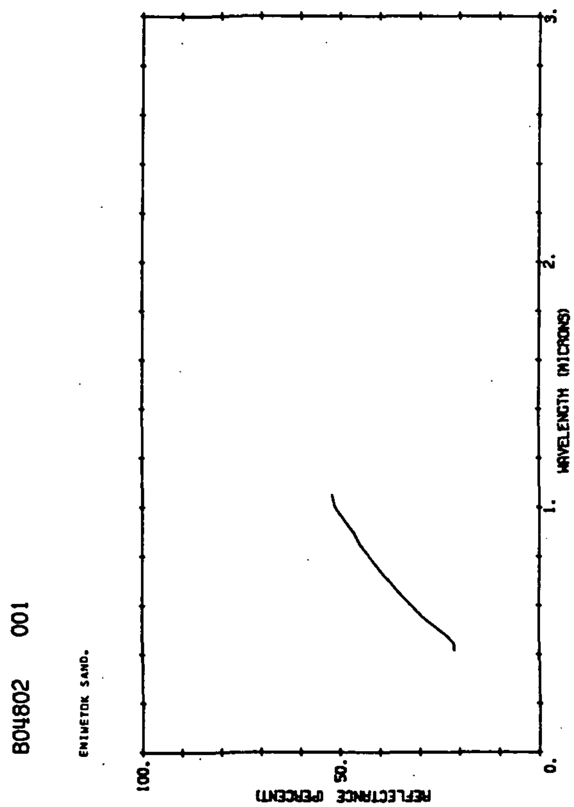
DRY YELLOWISH QUARTZ SAND, RODGERS QUARRY

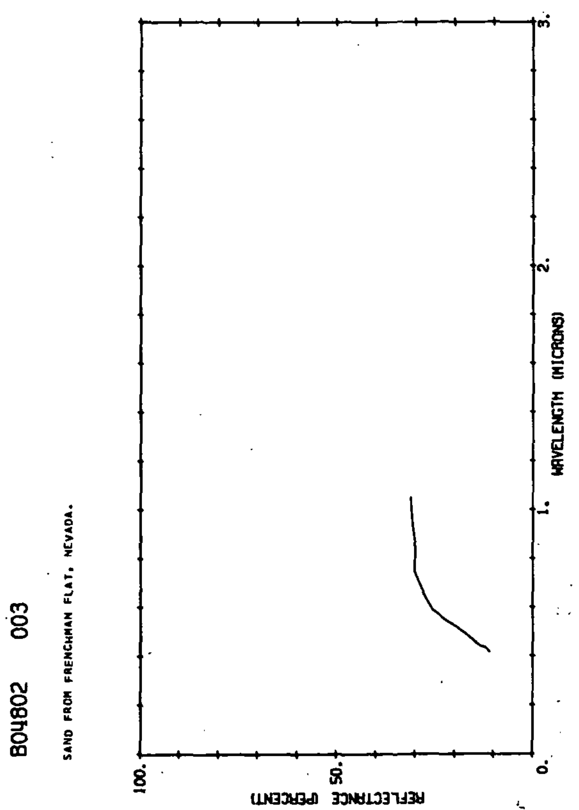


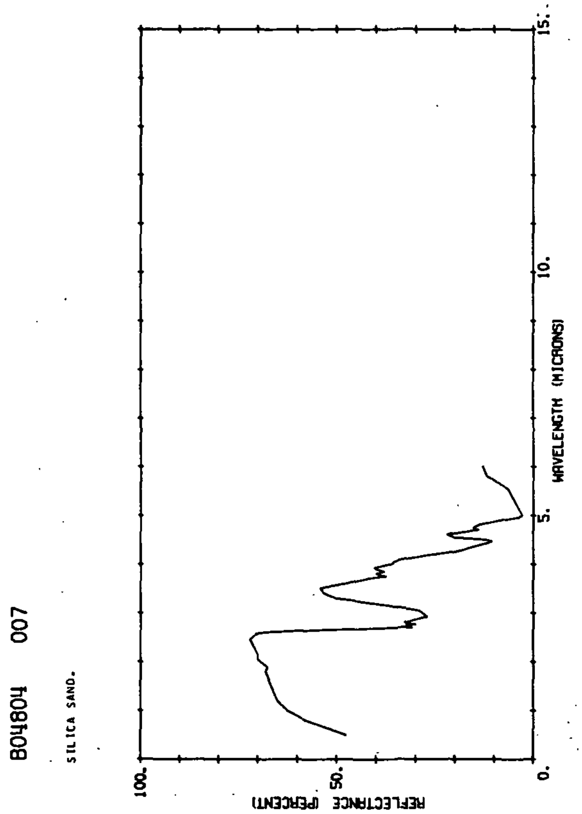

B01339 006
WET YELLOWISH QUARTZ SAND, RODGERS QUARRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

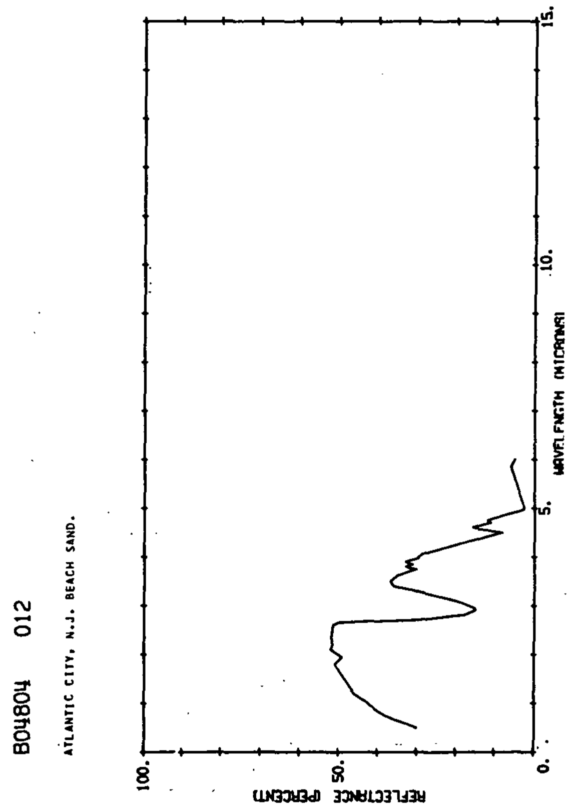

B04802 002
SAND FROM YUCCA, NEVADA.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

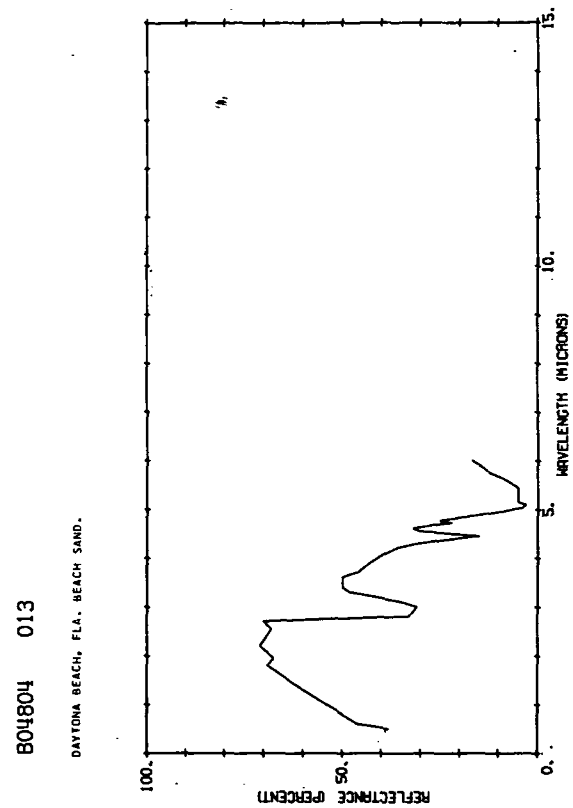

B01339 005
WET WHITE SAND, RODGERS QUARRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B04802 001
ENIWETOK SAND.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B04802 003
SAND FROM FRENCHMAN FLAT, NEVADA.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

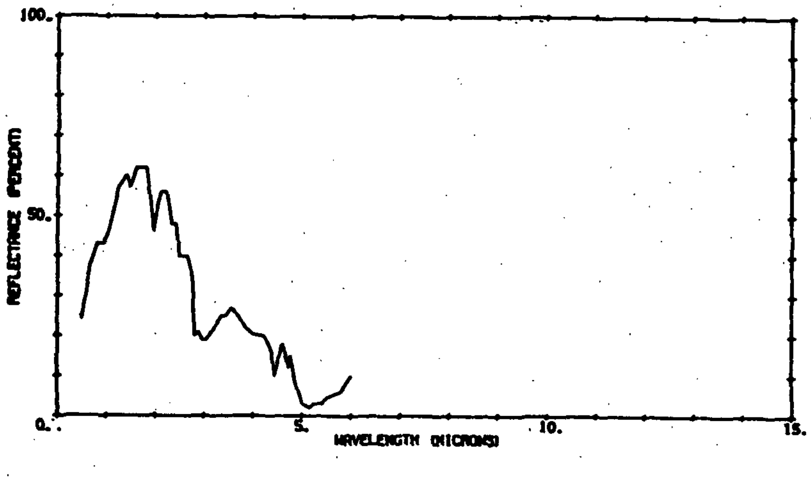

B04804 007
SILICA SAND.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
5.
10.
15.


B04804 012
ATLANTIC CITY, N.J. BEACH SAND.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
5.
10.
15.


B04804 013
DAYTONA BEACH, FLA. BEACH SAND.
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
5.
10.
15.

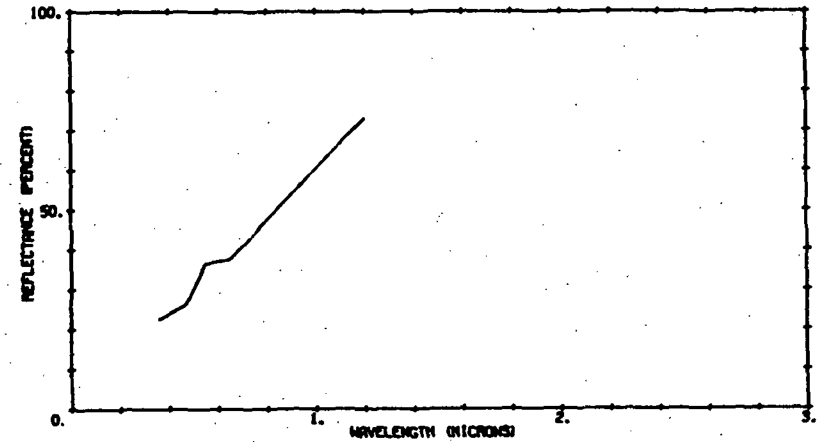
B04804 014

DAYTONA BEACH, FLA. BEACH SAND.



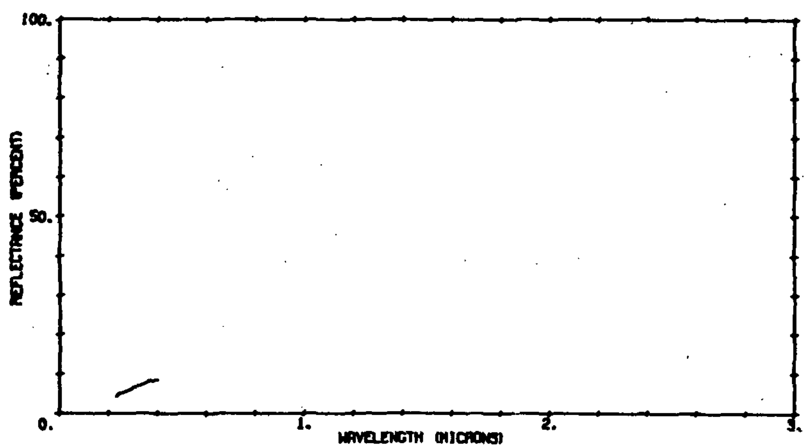
B13946 010

LIGHT YELLOW BEACH SAND, DRY.



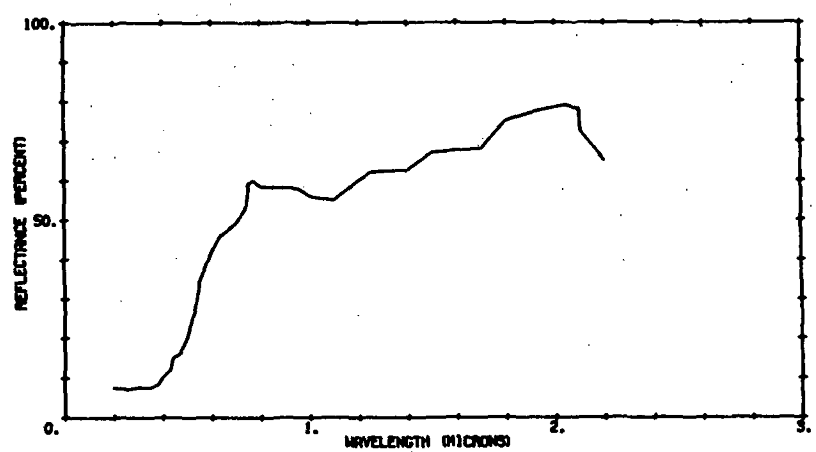
B14004 010

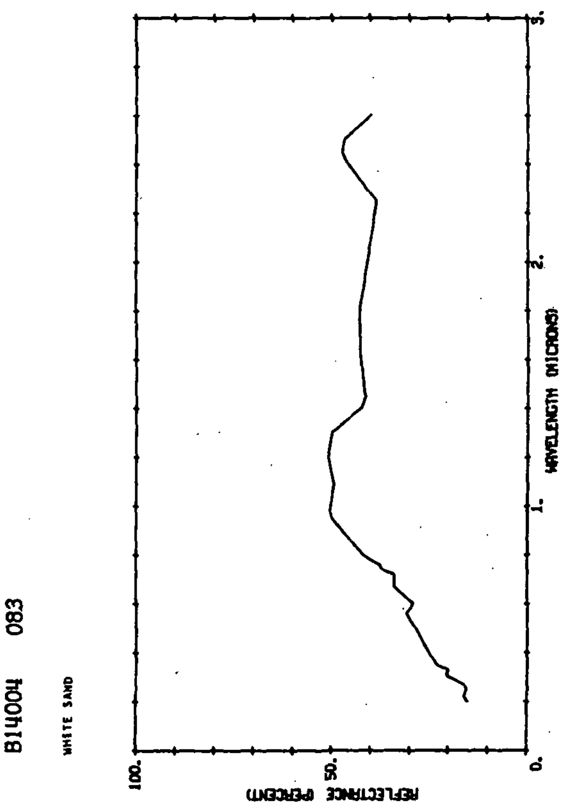
TAR-SAND SURFACE



B14004 082

YELLOW SAND




B14004 083
WHITE SAND
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

BFCB

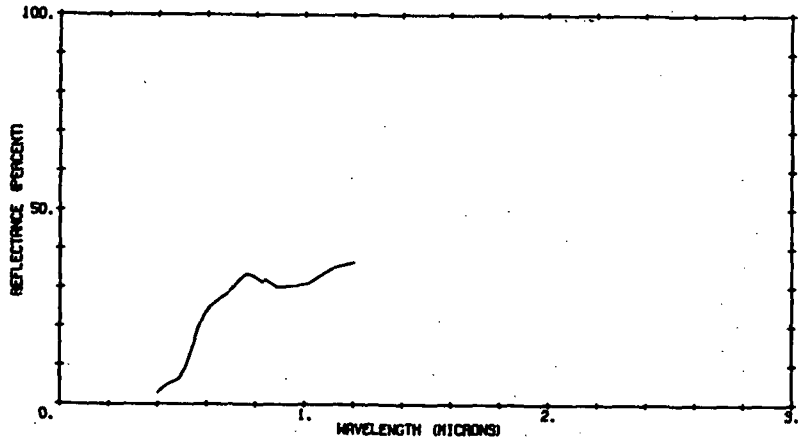
SOIL

Loamy Sand

217

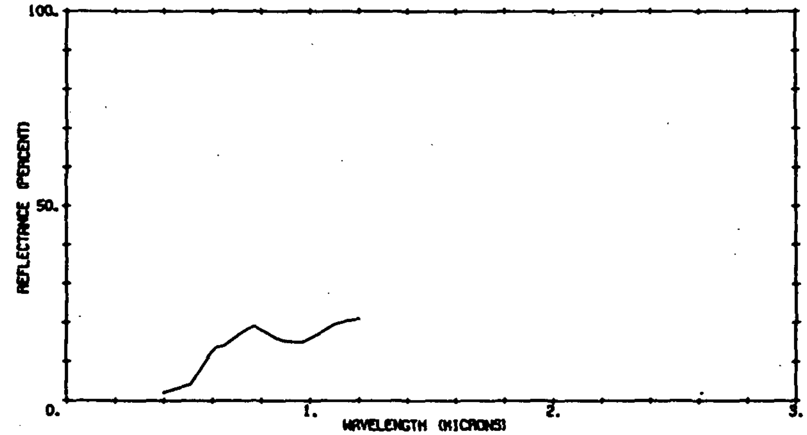
B00830 111

SAND, COLTS NECK LOAMY TYPE, NEW JERSEY, DRY



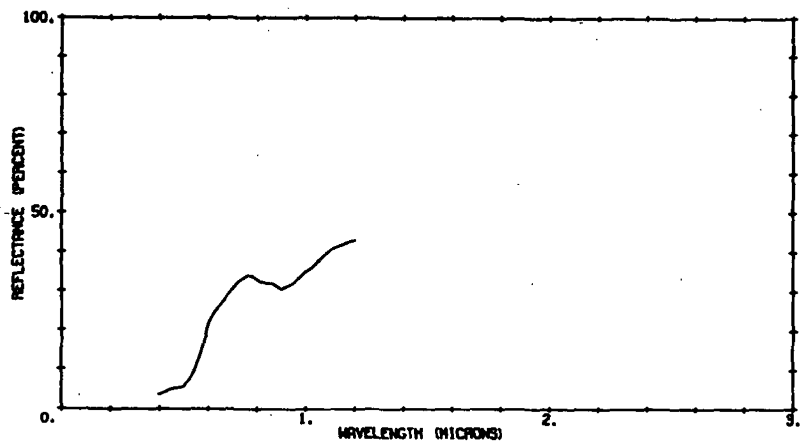
B00830 112

SAND, COLTS NECK LOAMY TYPE, NEW JERSEY, WET



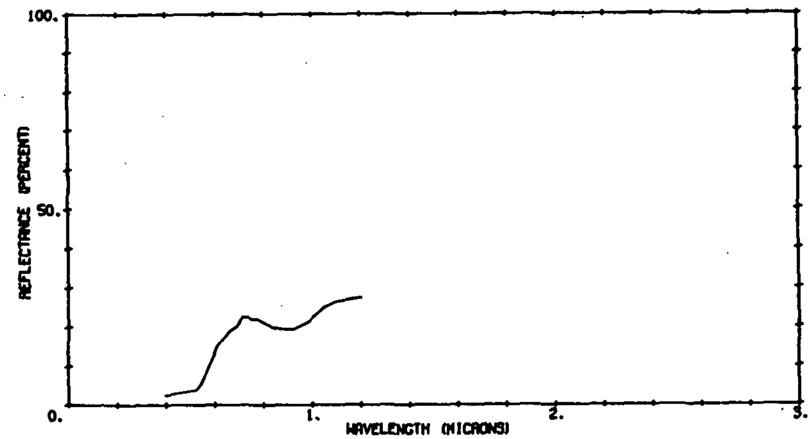
B00830 115

SAND, ORANGEBURG LOAMY TYPE, NORTH CAROLINA, DRY



B00830 116

SAND, ORANGEBURG LOAMY TYPE, NORTH CAROLINA, WET



BFD

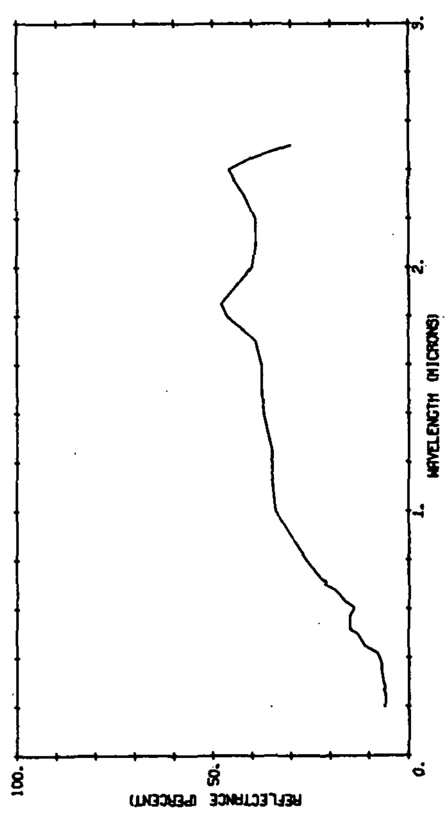
SOIL

Moderately Coarse Textured

BFD 1

B14004 081

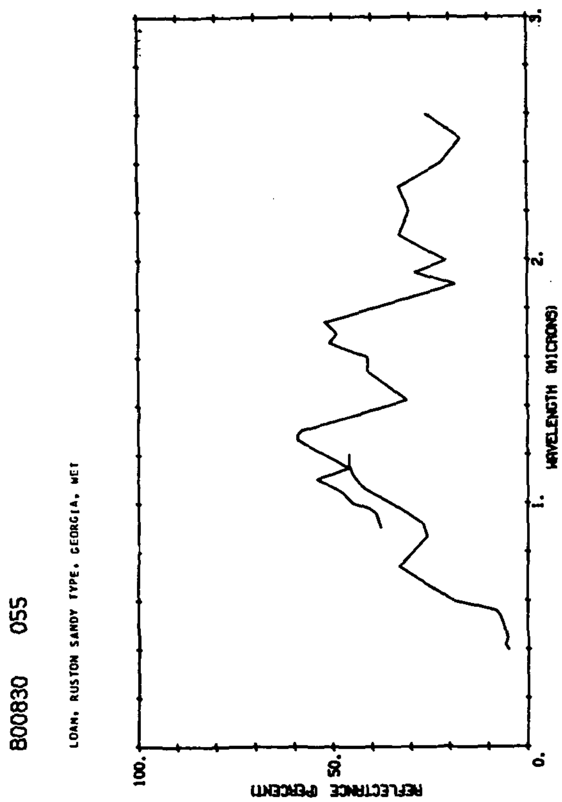
BLACK SANDY DIRT

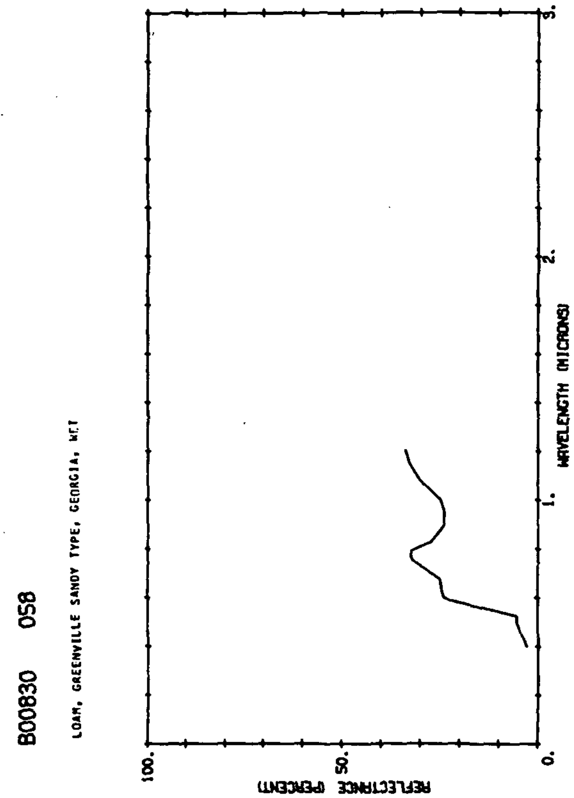


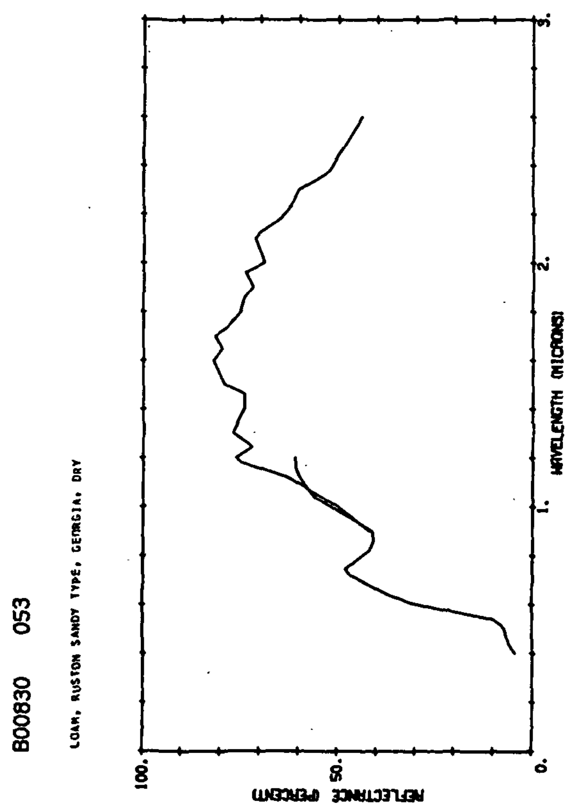
BFDA

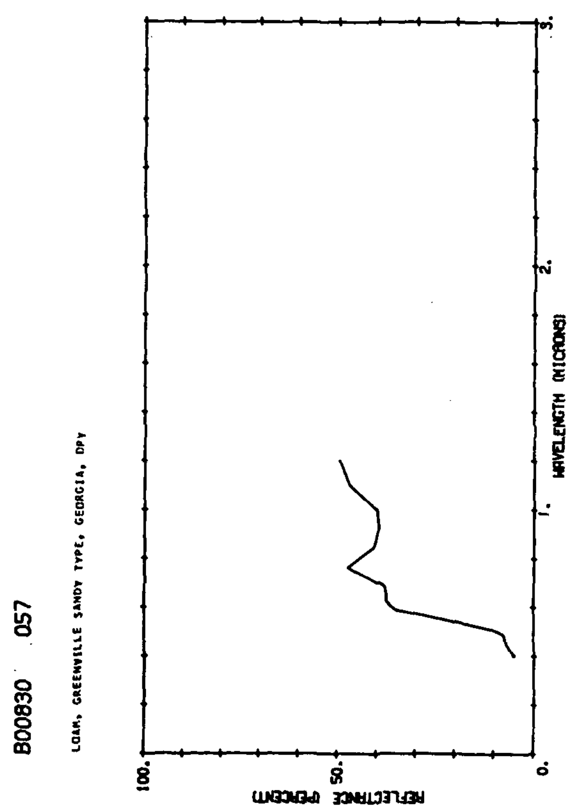
SOIL

Sandy Loam


B00830 055
LOAM, RUSTON SANDY TYPE, GEORGIA, WET
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

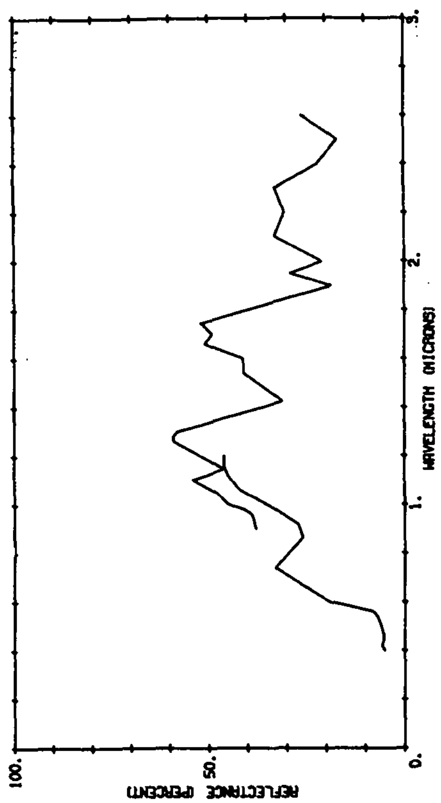

B00830 058
LOAM, GREENVILLE SANDY TYPE, GEORGIA, WET
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B00830 053
LOAM, RUSTON SANDY TYPE, GEORGIA, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B00830 057
LOAM, GREENVILLE SANDY TYPE, GEORGIA, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

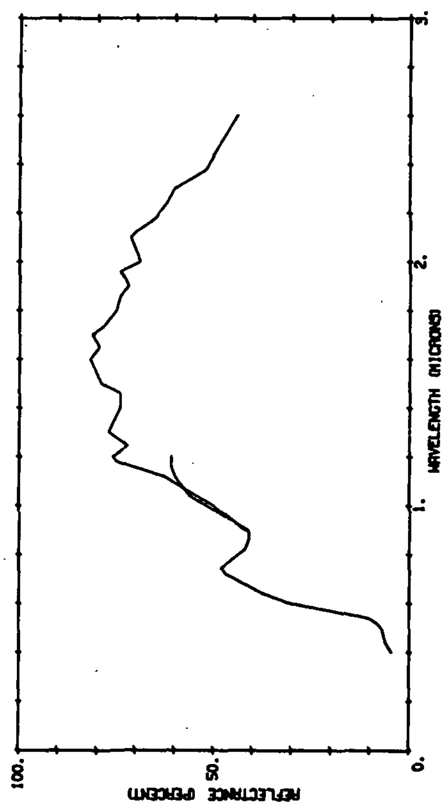
B00830 055

LOAM, RUSTON SANDY TYPE, GEORGIA, WET



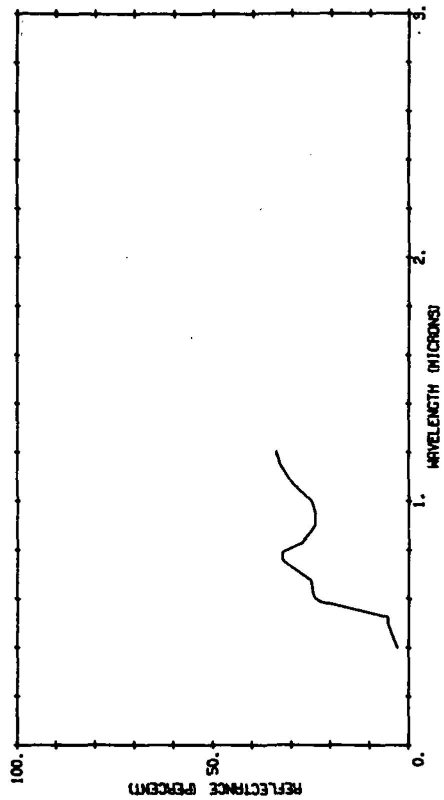
B00830 053

LOAM, RUSTON SANDY TYPE, GEORGIA, DRY



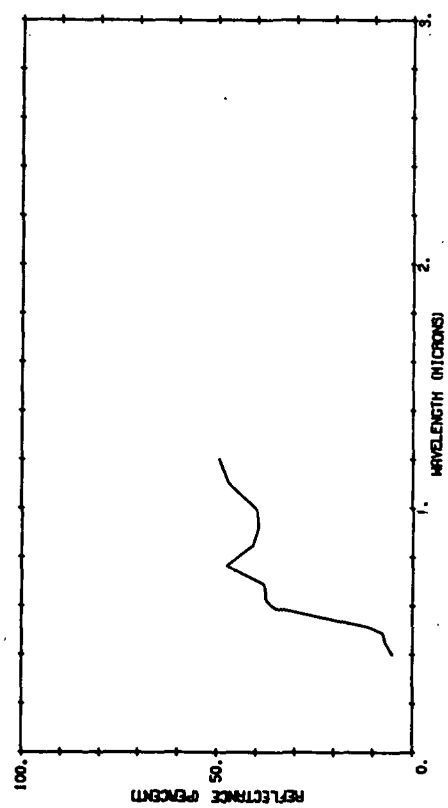
B00830 058

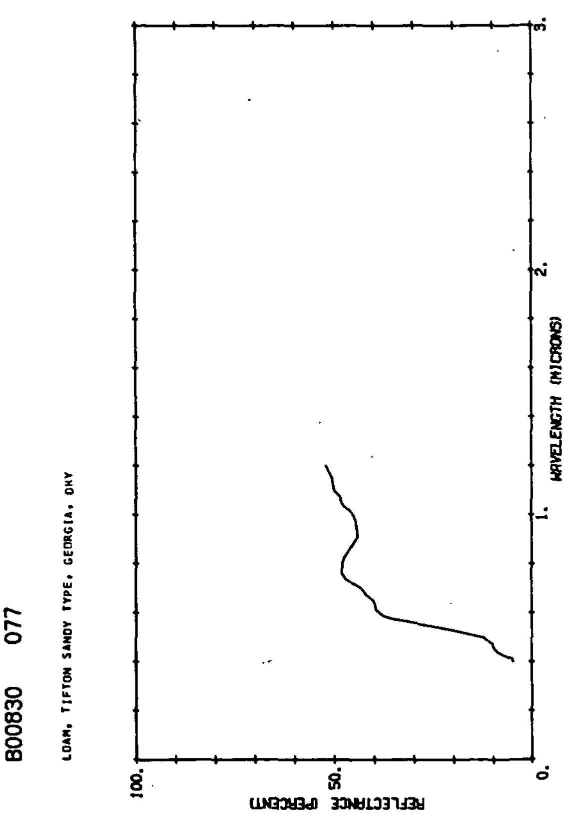
LOAM, GREENVILLE SANDY TYPE, GEORGIA, WET



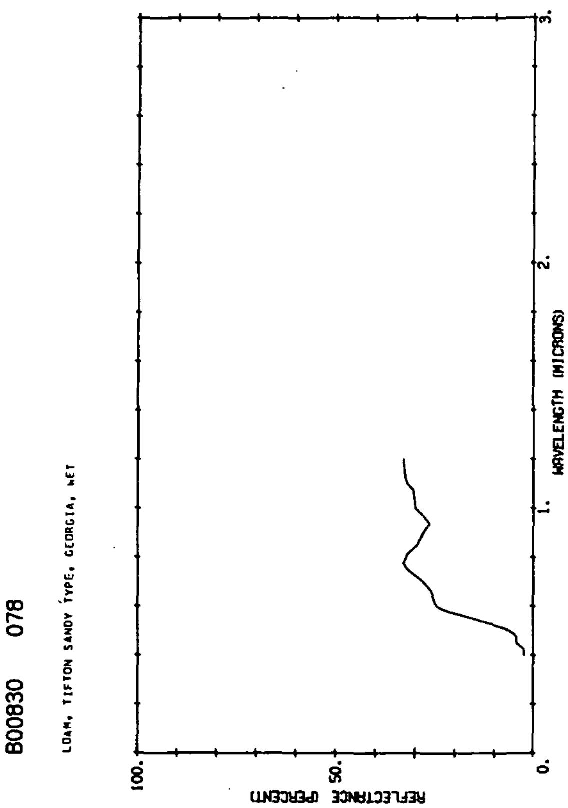
B00830 057

LOAM, GREENVILLE SANDY TYPE, GEORGIA, DRY

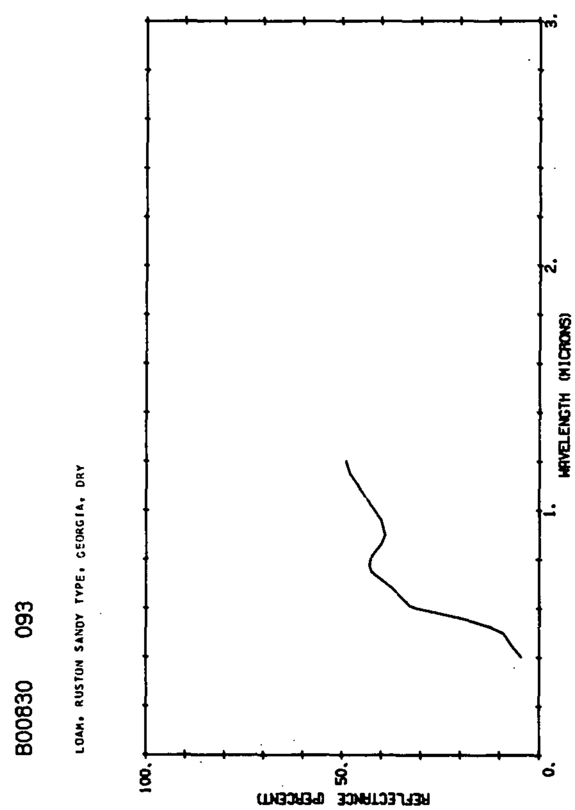




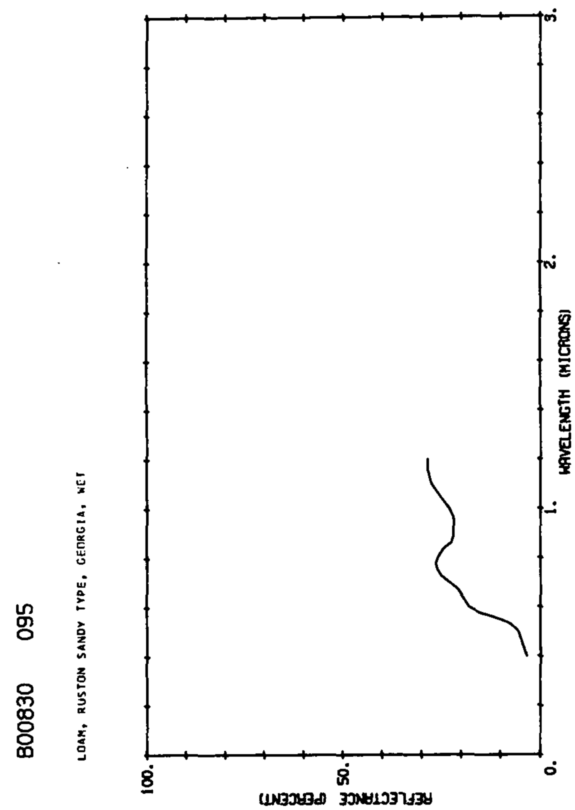
B00830 077
LOAM, TIFTON SANDY TYPE, GEORGIA, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.



B00830 078
LOAM, TIFTON SANDY TYPE, GEORGIA, WET
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.



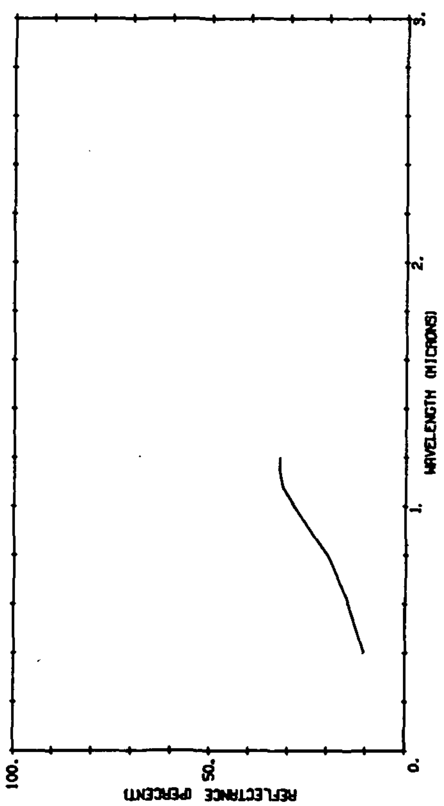
B00830 093
LOAM, RUSTON SANDY TYPE, GEORGIA, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.



B00830 095
LOAM, RUSTON SANDY TYPE, GEORGIA, WET
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

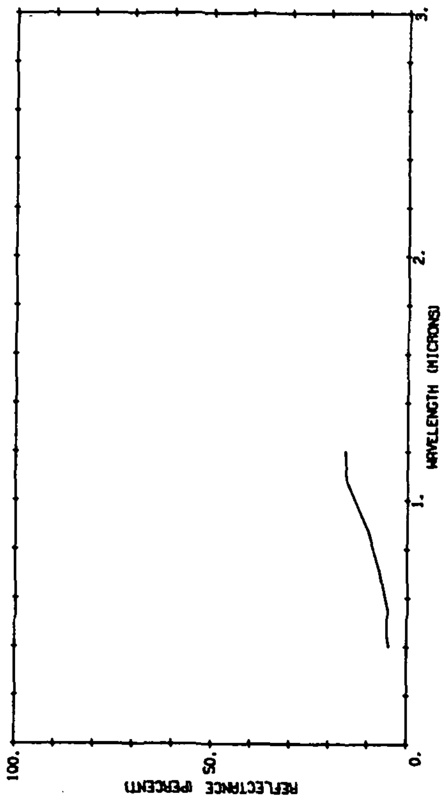
B00830 121

LOAM, GRADY SANDY TYPE, GEORGIA, DRY



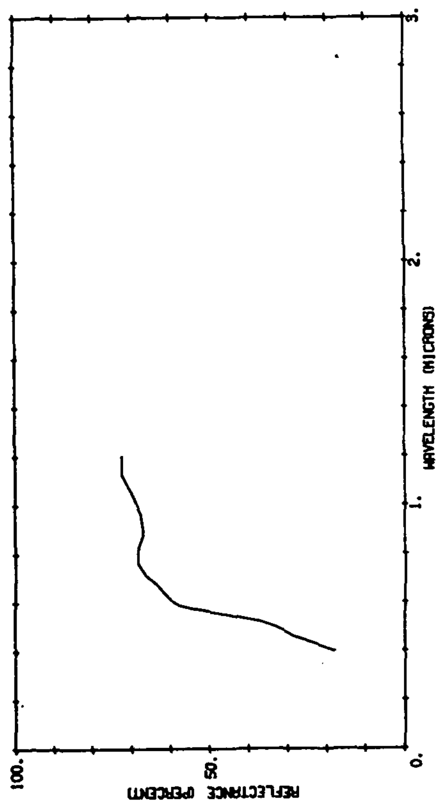
B00830 122

LOAM, GRADY SANDY TYPE, GEORGIA, WET



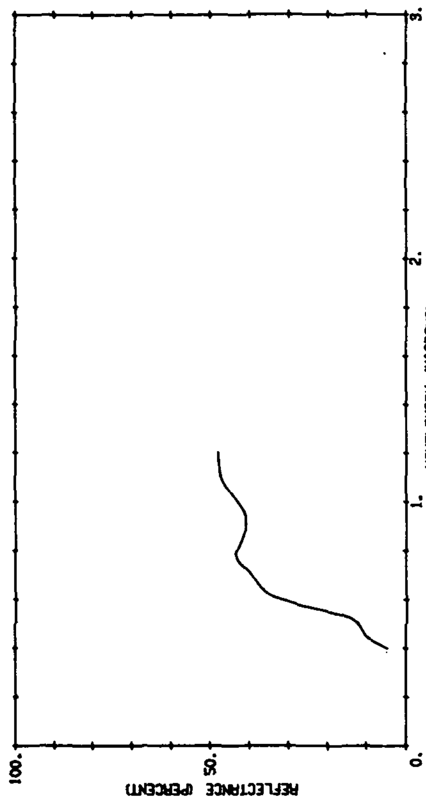
B00830 129

LOAM, RUSTON SANDY TYPE, GEORGIA, DRY



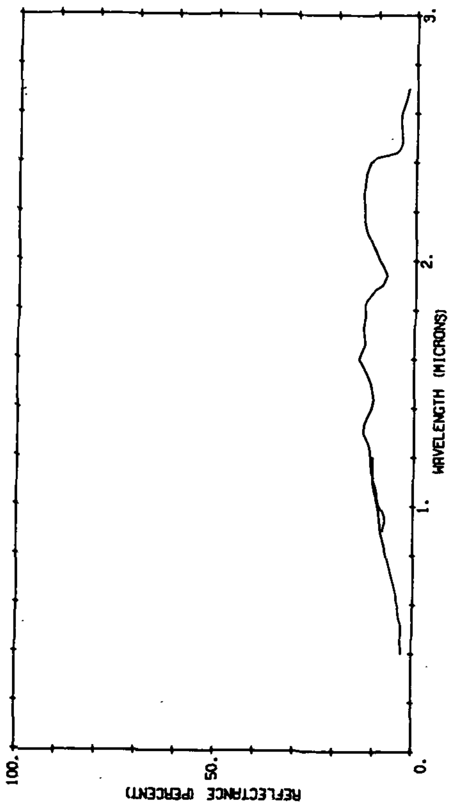
B00830 130

LOAM, RUSTON SANDY TYPE, GEORGIA, WET



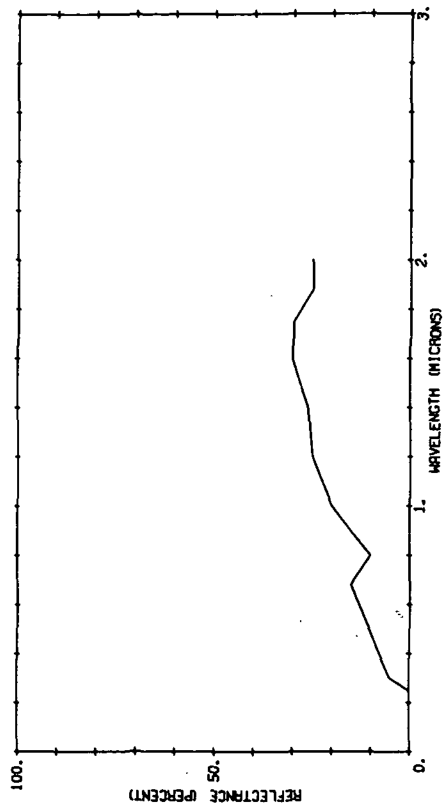
B00830 193

LOAM, BLACK VOLCANIC SANDY TYPE, W. COAST GUATEMALA, WET



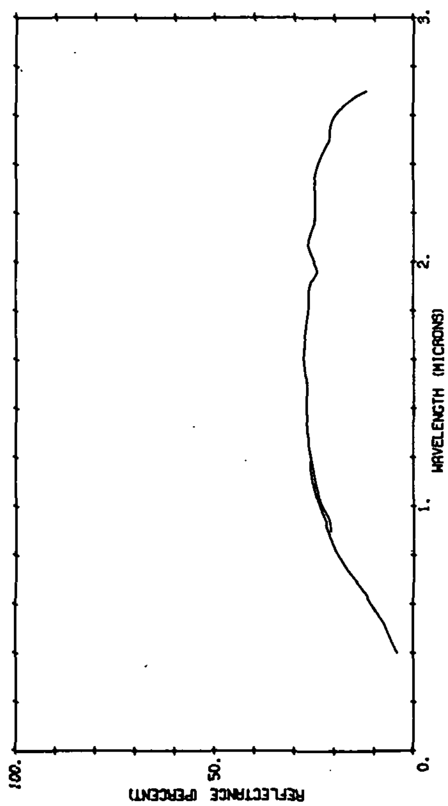
B13946 034

SANDY LOAM.



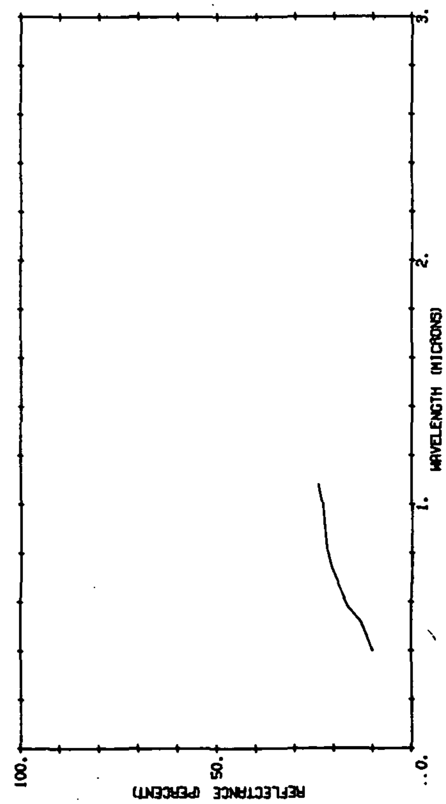
B00830 191

LOAM, BLACK VOLCANIC SANDY TYPE, W. COAST GUATEMALA, DRY



B01339 007

DAMP COLLINGTON SANDY LOAM



BFDB

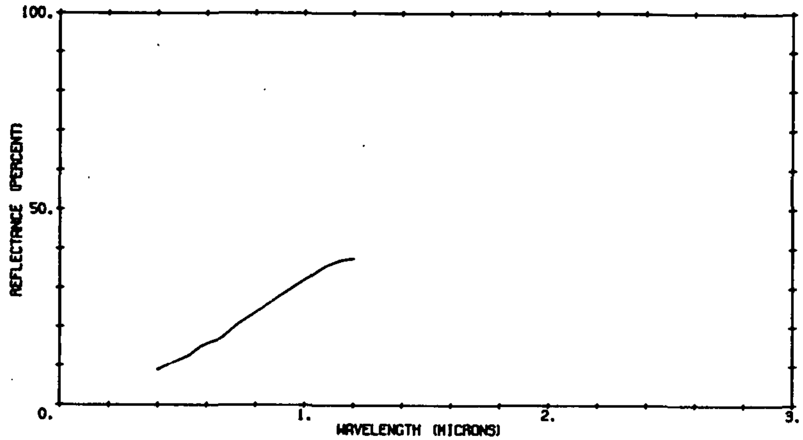
SOIL

Fine Sandy Loam

226

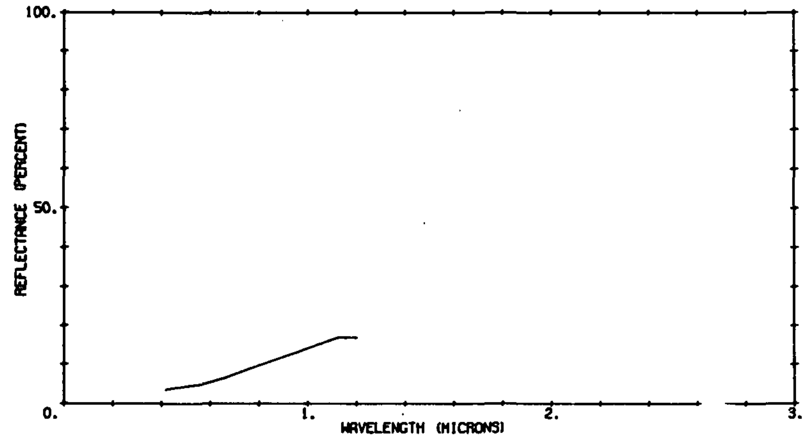
B00830 066

LOAM, HALL, VERY FINE SANDY TYPE, NEBRASKA, DRY



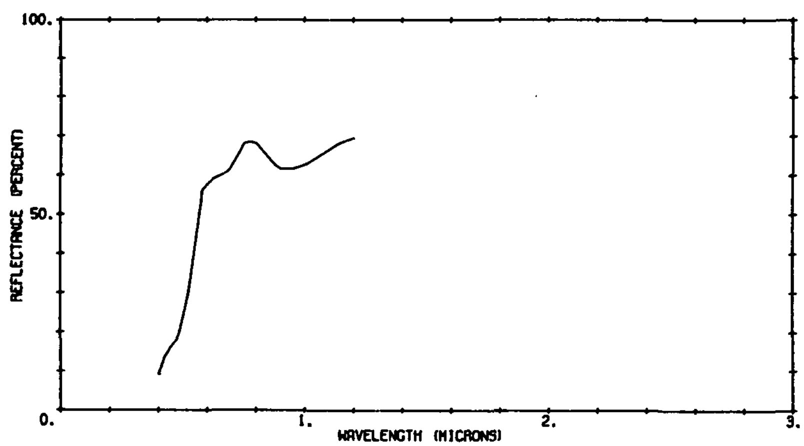
B00830 068

LOAM, HALL, VERY FINE SANDY TYPE, NEBRASKA, WET



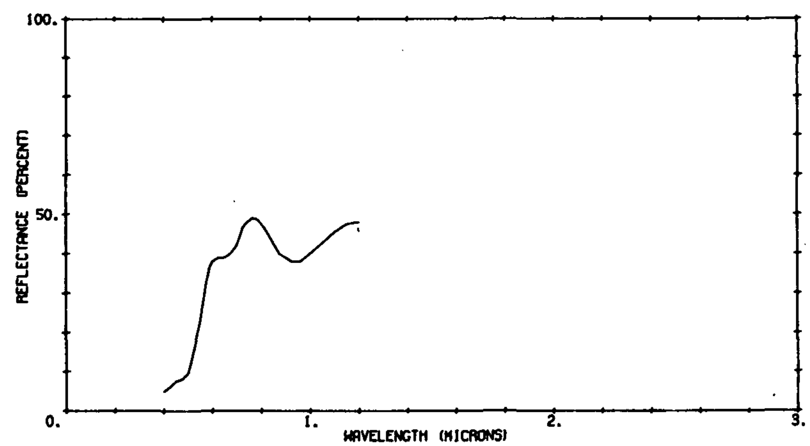
B00830 069

LOAM, SANTA BARBARA GRAVELLY FINE SANDY TYPE, CUBA, DRY



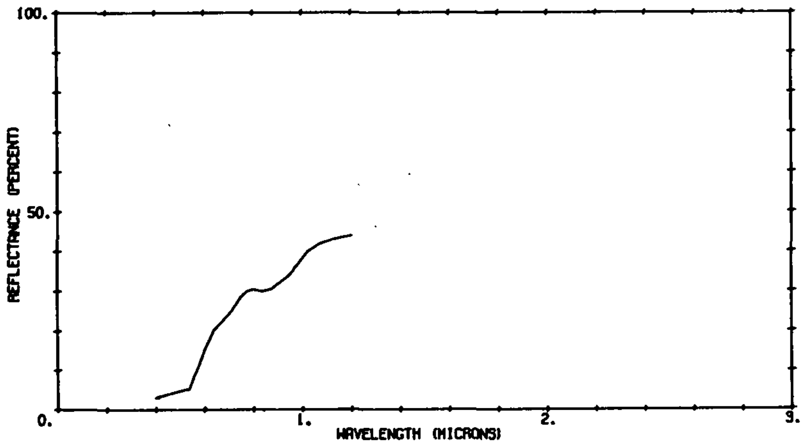
B00830 070

LOAM, SANTA BARBARA GRAVELLY FINE SANDY TYPE, CUBA, WET



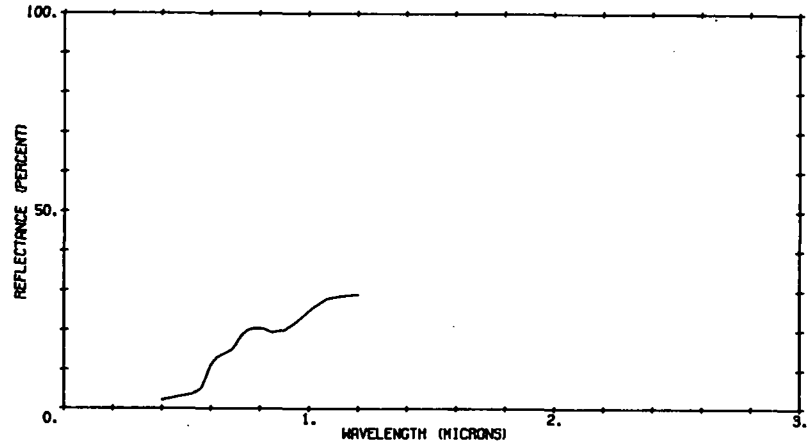
B00830 073

LOAM, TILLMAN FINE SANDY TYPE, OKLAHOMA, DRY



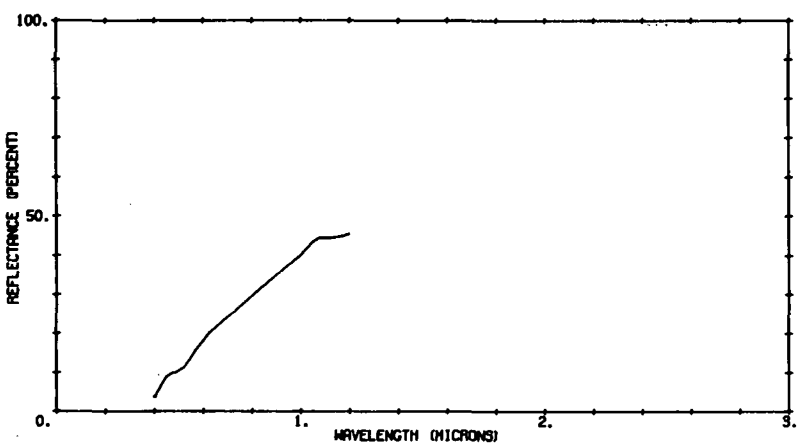
B00830 074

LOAM, TILLMAN FINE SANDY TYPE, OKLAHOMA, WET



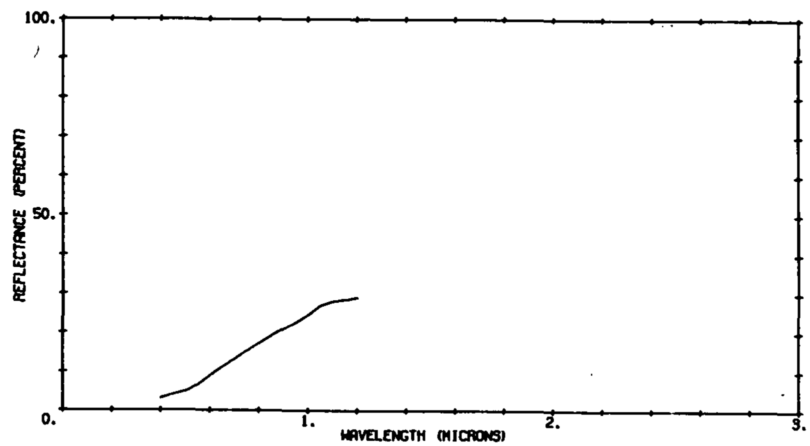
B00830 085

LOAM, PUTNAM FINE SANDY TYPE, OKLAHOMA, DRY



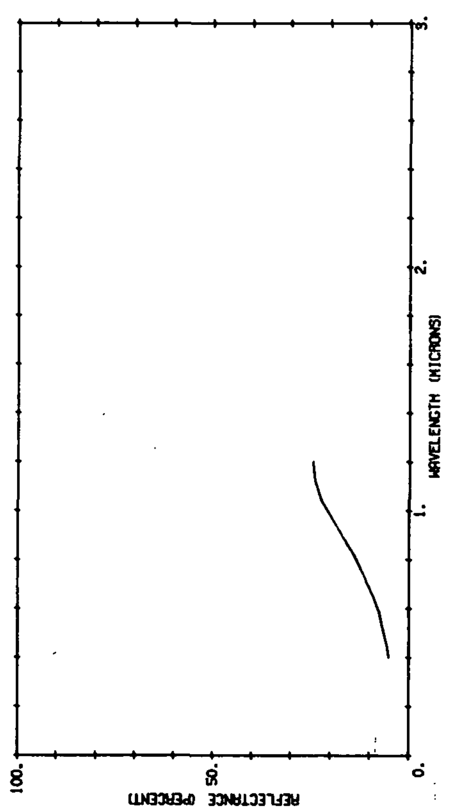
B00830 086

LOAM, PUTNAM FINE SANDY TYPE, OKLAHOMA, WET



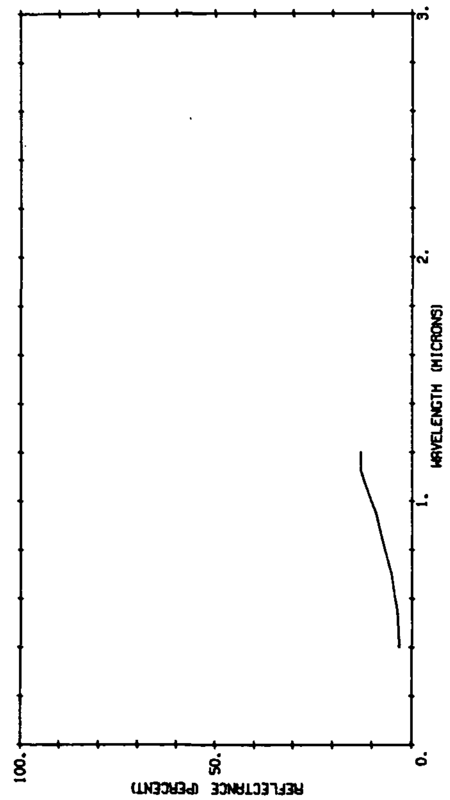
B00830 087

LOAM, BARNES FINE SANDY TYPE, SOUTH DAKOTA, DRY



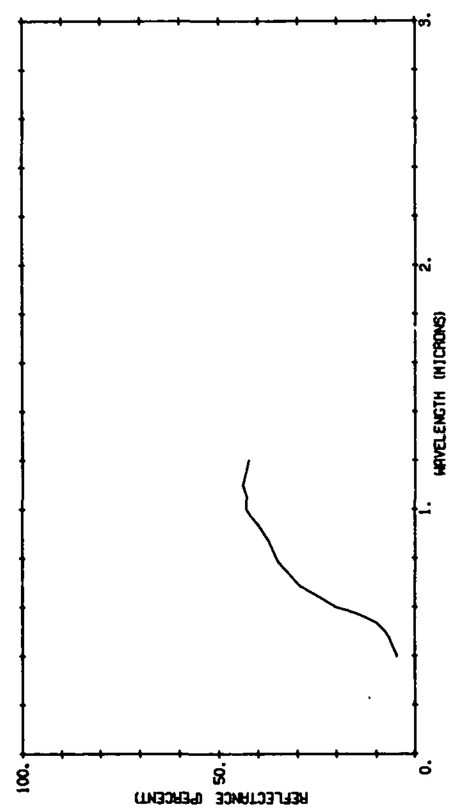
B00830 088

LOAM, BARNES FINE SANDY TYPE, SOUTH DAKOTA, WET



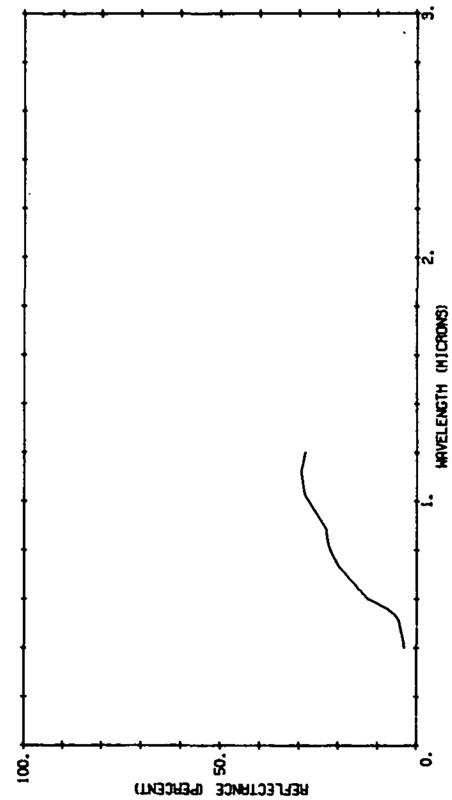
B00830 103

LOAM, VERNON VERY FINE SANDY, TEXAS, DRY



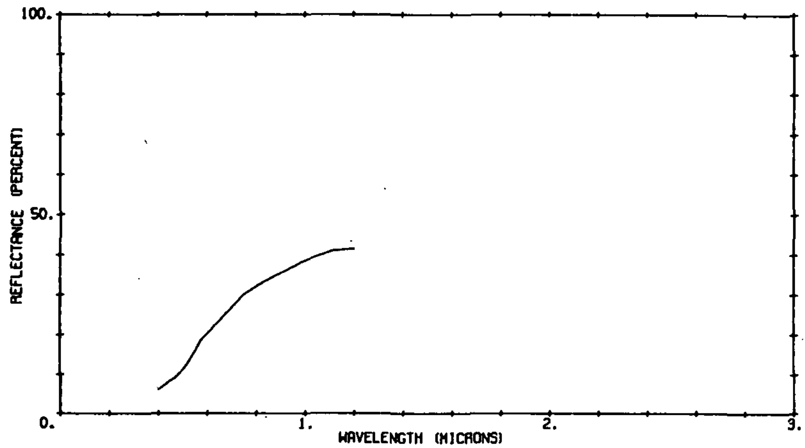
B00830 104

LOAM, VERNON VERY FINE SANDY, TEXAS, WET



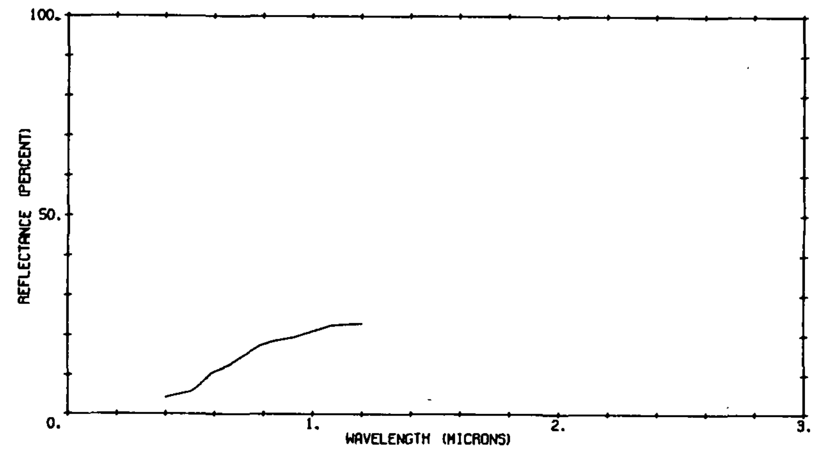
B00830 137

LOAM, WELD FINE SANDY TYPE, COLORADO, DRY



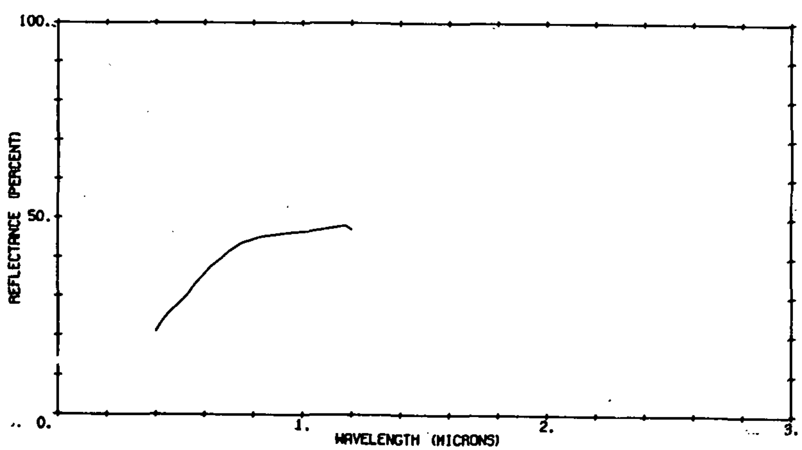
B00830 138

LOAM, WELD FINE SANDY TYPE, COLORADO, WET



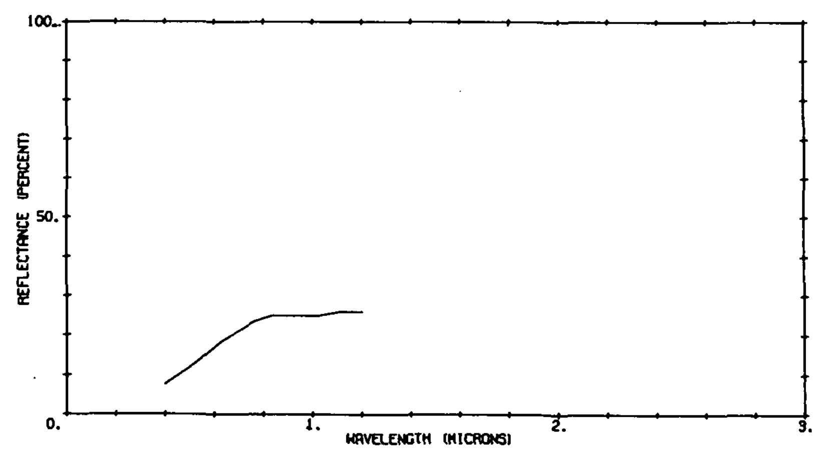
B00830 144

LOAM, GOOCH FINE SANDY TYPE, OREGON, DRY



B00830 146

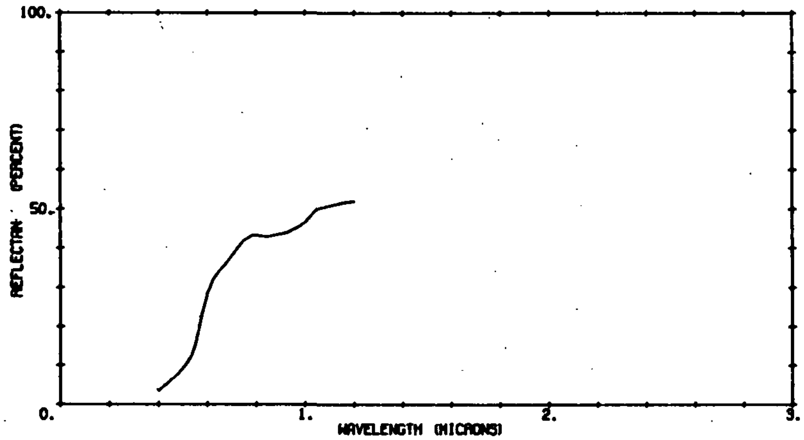
LOAM, GOOCH FINE SANDY TYPE, OREGON, WET



C-5

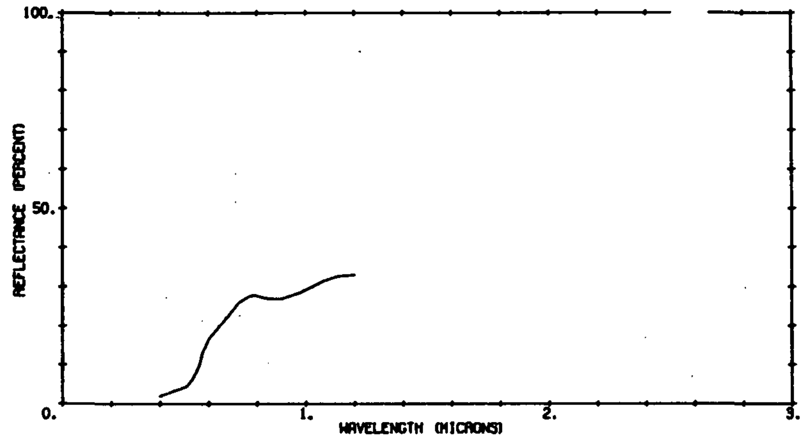
B00830 147

LOAM, ORANGEBURG FINE SANDY TYPE, LOUISIANA, DRY



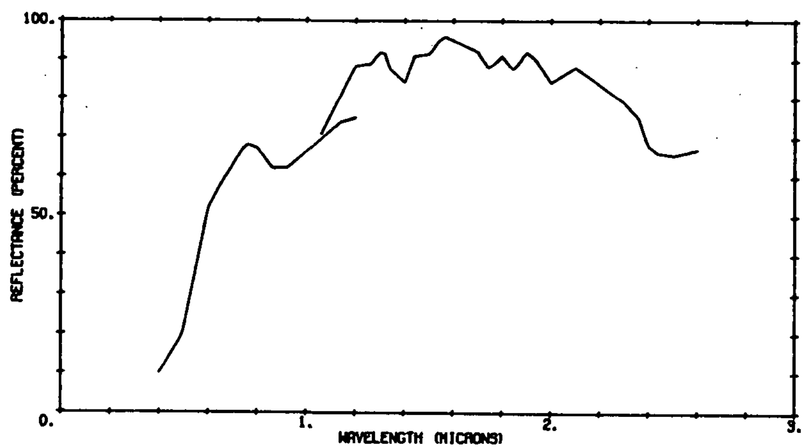
B00830 148

LOAM, ORANGEBURG FINE SANDY TYPE, LOUISIANA, WET



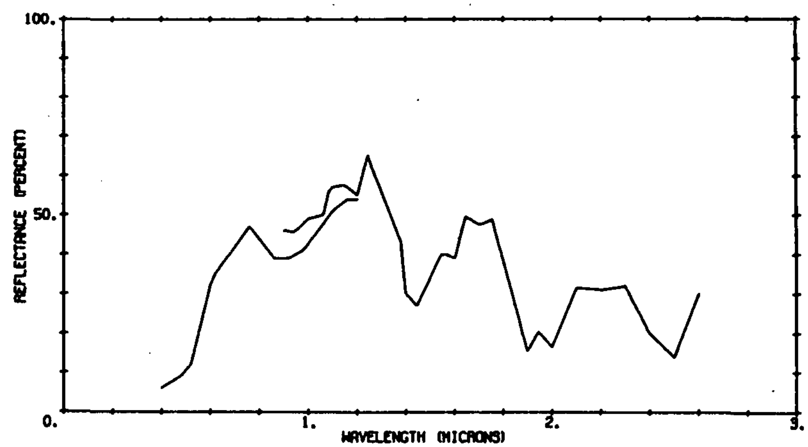
B00830 163

LOAM, SANTA BARBARA, GRAVELLY FINE SANDY TYPE, CUBA, DRY



B00830 165

LOAM, SANTA BARBARA, GRAVELLY FINE SANDY TYPE, CUBA, WET



BFEA

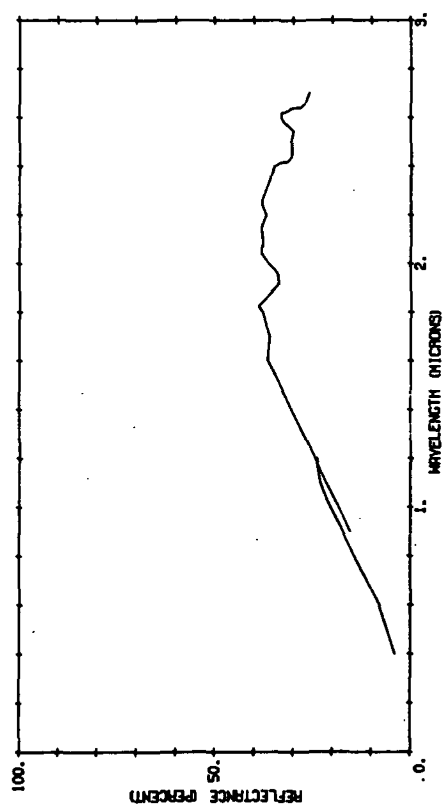
SOIL

Loam

232

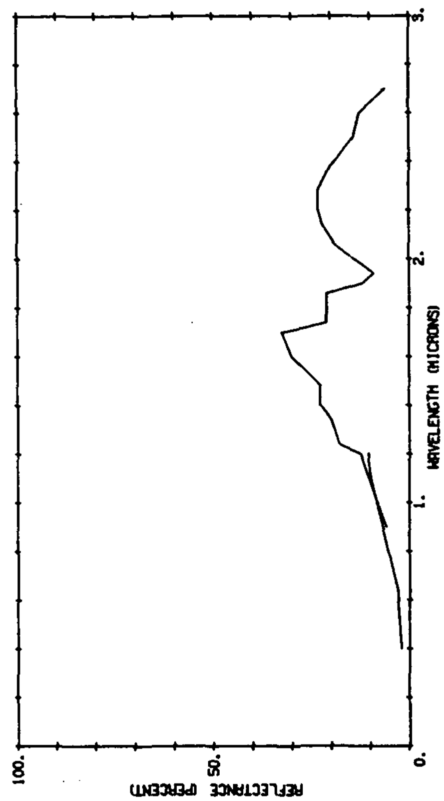
B00830 017

LOAM, CLARION, DRY, FROM IOWA



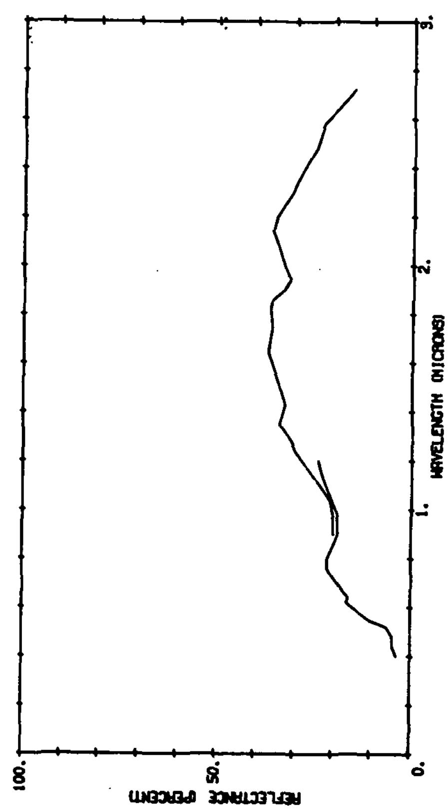
B00830 019

LOAM, CLARION, WET, FROM IOWA



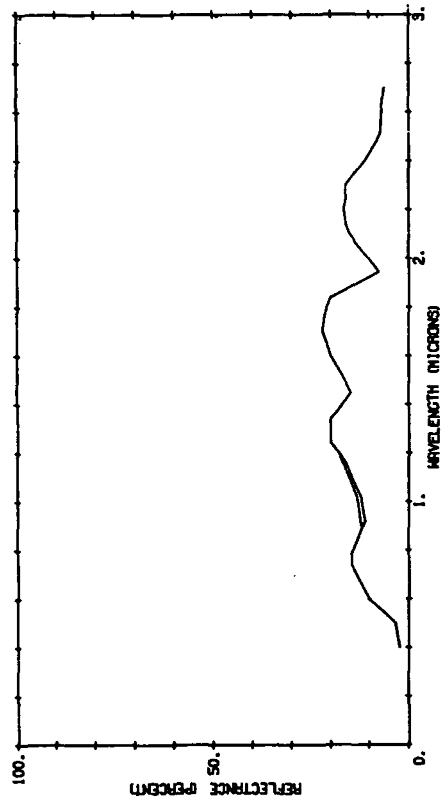
B00830 049

LOAM, COLTS NECK TYPE FROM NEW JERSEY, DRY



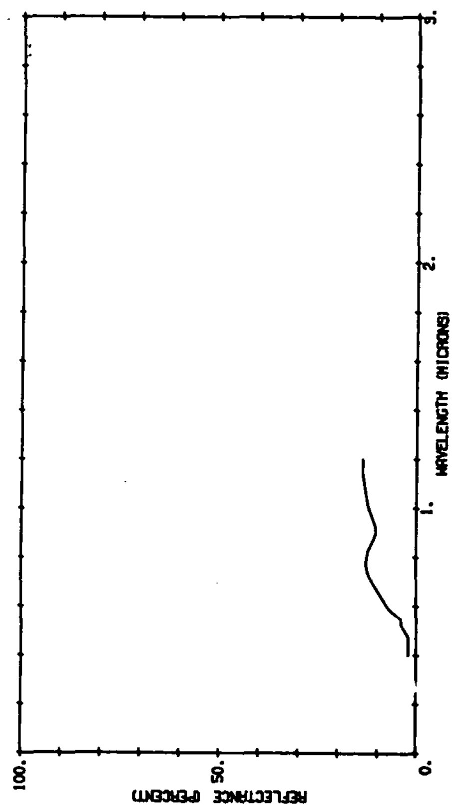
B00830 051

LOAM, COLTS NECK TYPE FROM NEW JERSEY, WET



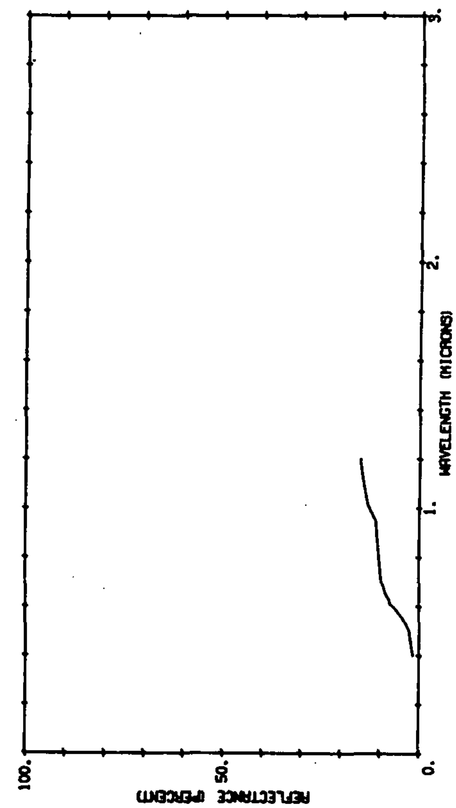
B00830 060

LOAM, COLTS NECK TYPE, NEW JERSEY, WET



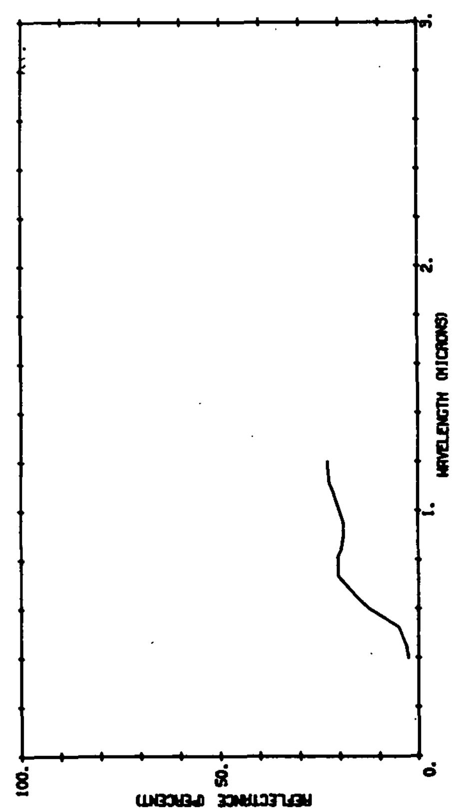
B00830 064

LOAM, BLAKELY TYPE FROM GEORGIA, WET



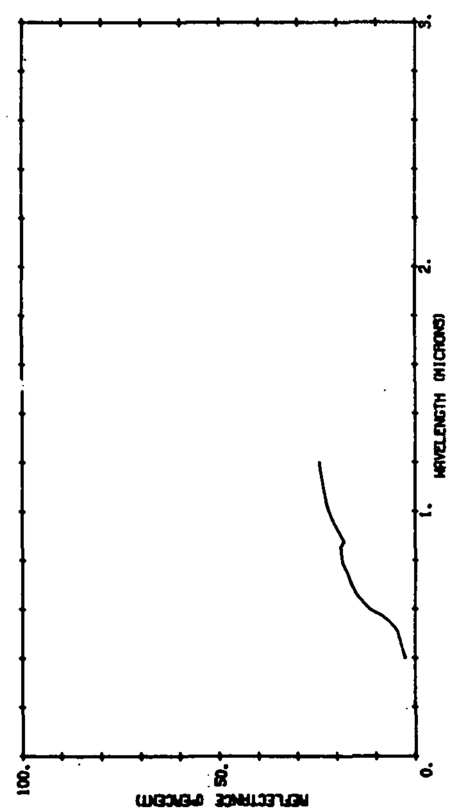
B00830 059

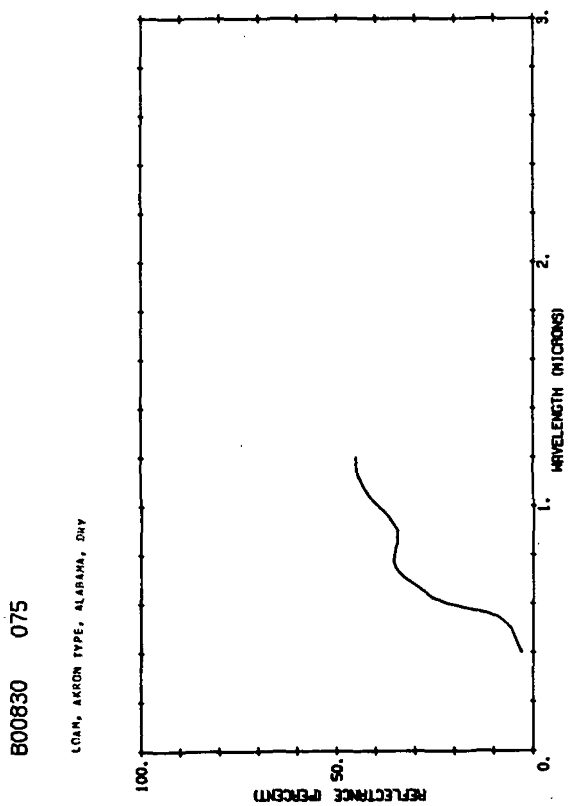
LOAM, COLTS NECK TYPE, NEW JERSEY, DRY

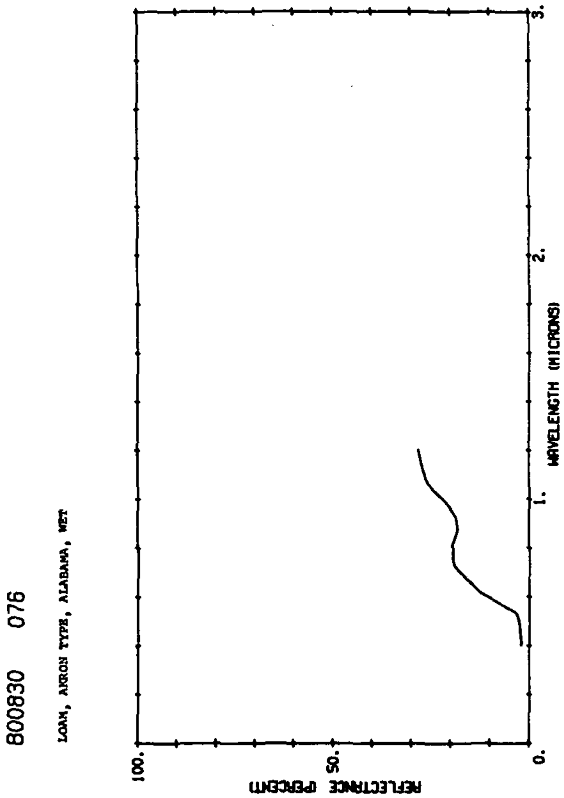


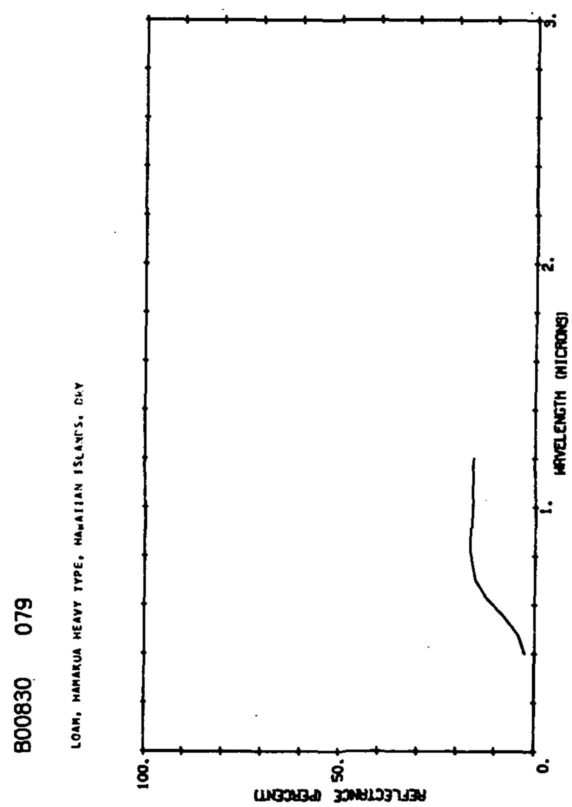
B00830 062

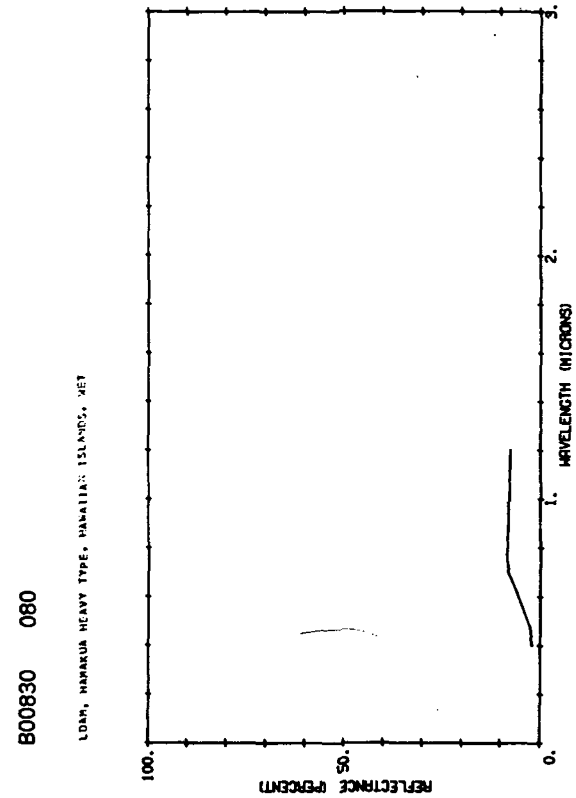
LOAM, BLAKELY TYPE FROM GEORGIA, DRY

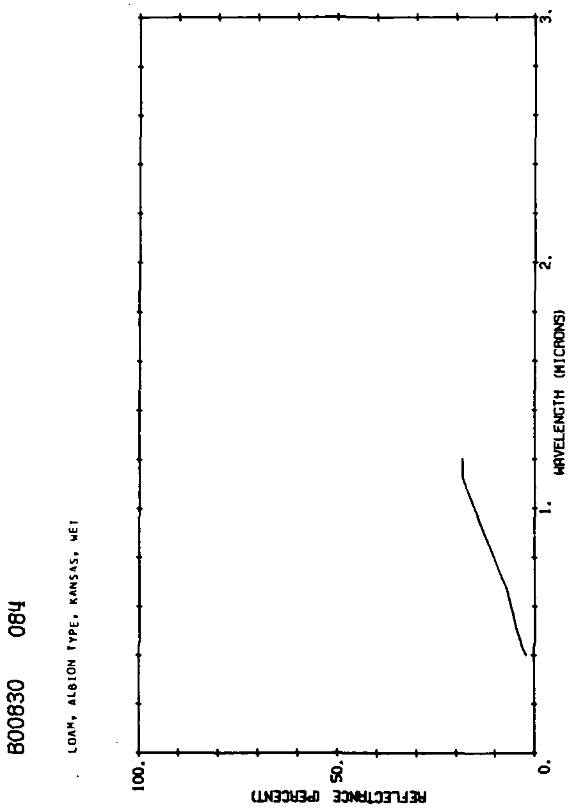


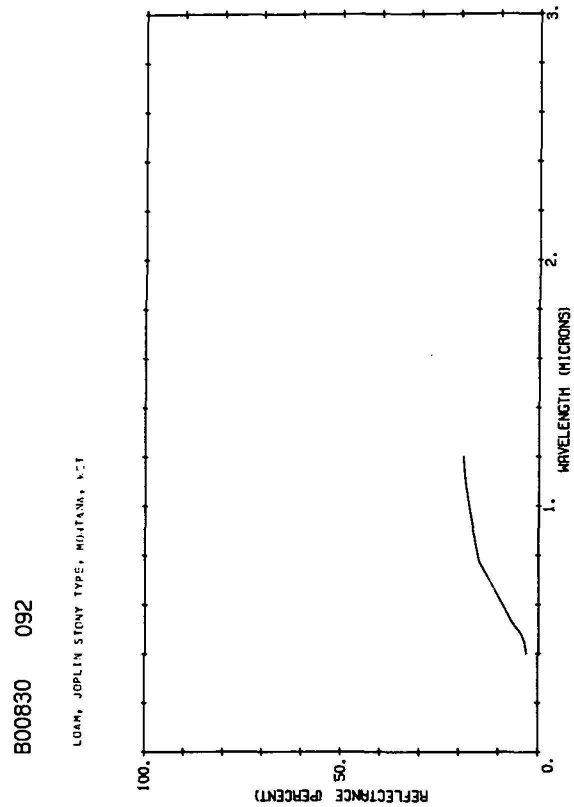

B00830 075
LOAM, AKRON TYPE, ALABAMA, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

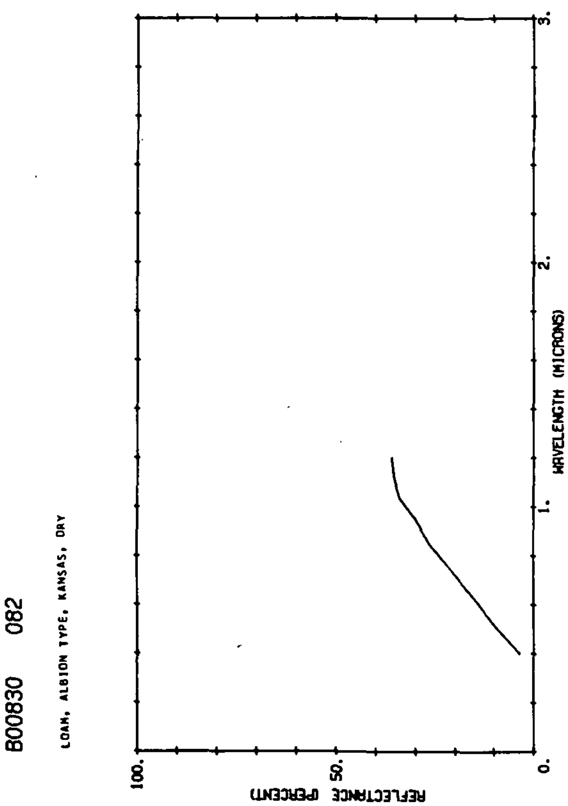

B00830 076
LOAM, AKRON TYPE, ALABAMA, WET
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

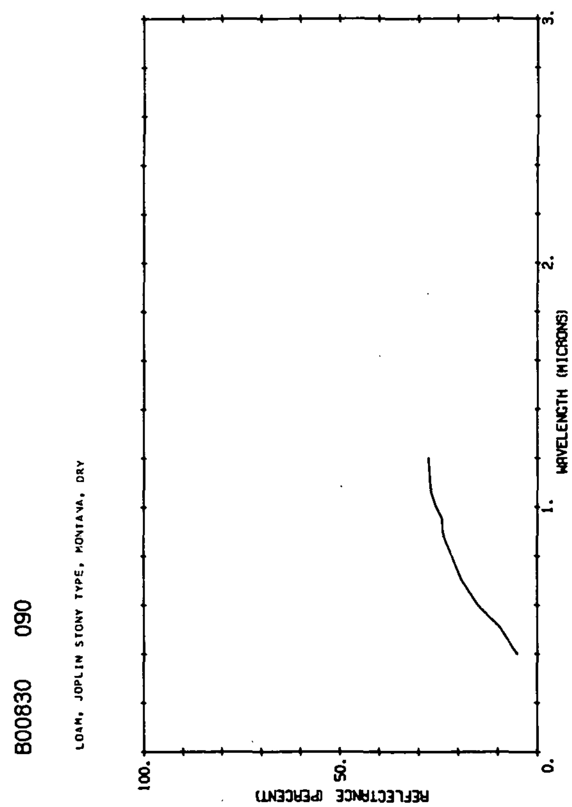

B00830 079
LOAM, HAMAKUA HEAVY TYPE, HAWAIIAN ISLANDS, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B00830 080
LOAM, HAMAKUA HEAVY TYPE, HAWAIIAN ISLANDS, WET
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B00830 084
LOAM, ALBION TYPE, KANSAS, WET
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

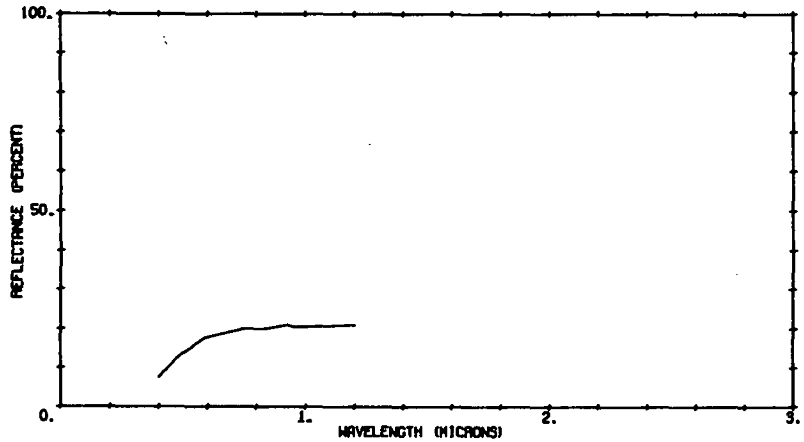

B00830 092
LOAM, JOPLIN STONY TYPE, MONTANA, WET
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B00830 082
LOAM, ALBION TYPE, KANSAS, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B00830 090
LOAM, JOPLIN STONY TYPE, MONTANA, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

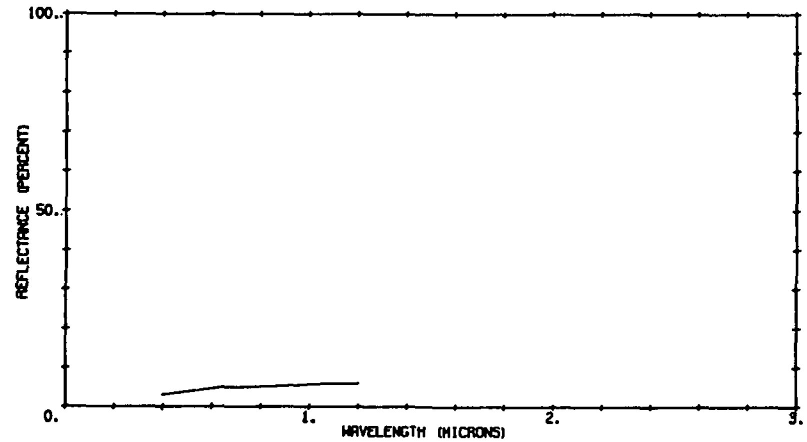
B00830 131

LOAM, ONOMEA TYPE, HAWAIIAN ISLANDS, DRY



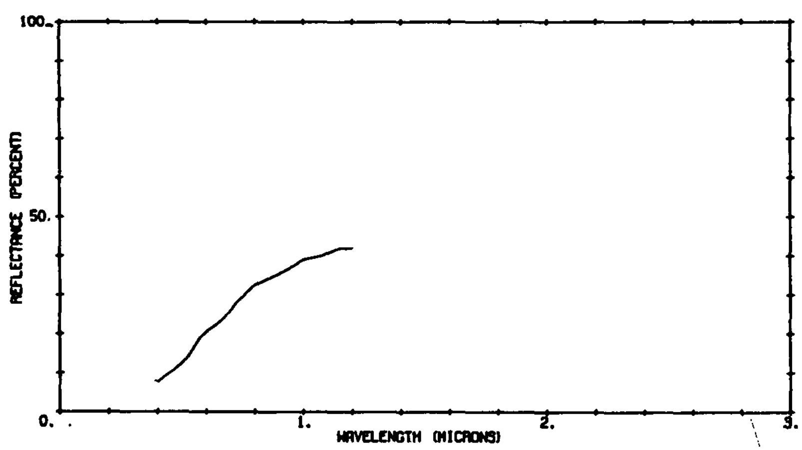
B00830 132

LOAM, ONOMEA TYPE, HAWAIIAN ISLANDS, WET



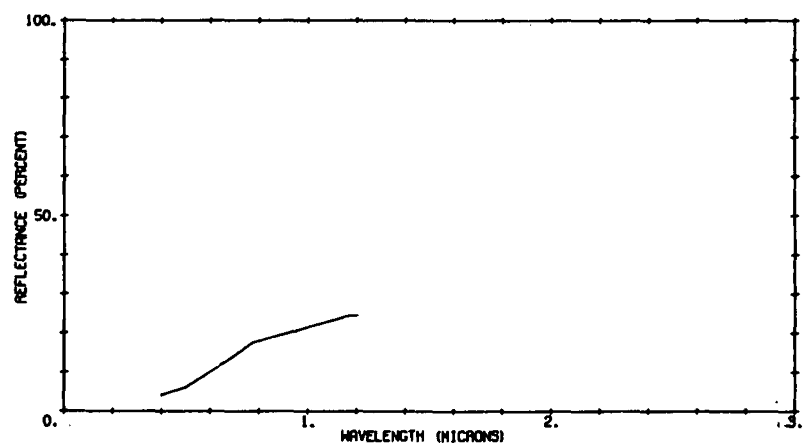
B00830 133

LOAM, WELD TYPE, COLORADO, DRY



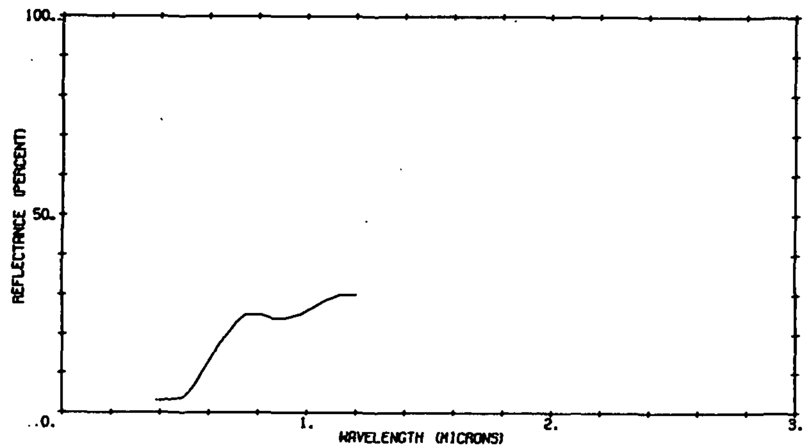
B00830 134

LOAM, WELD TYPE, COLORADO, WET



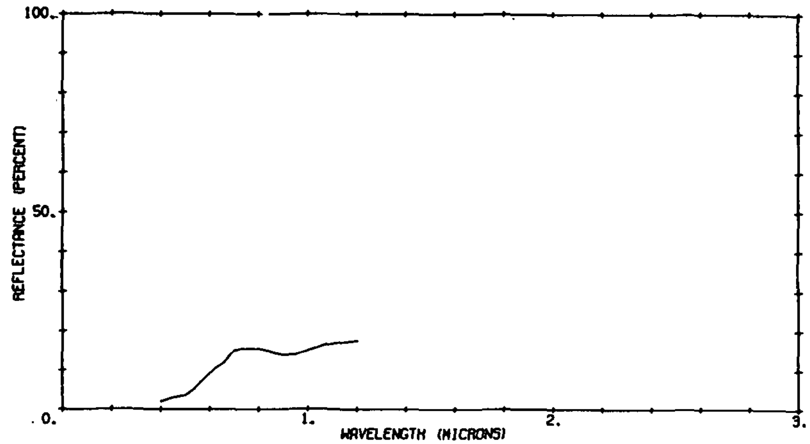
B00830 141

LOAM, COLTS NECK TYPE, NEW JERSEY, DRY



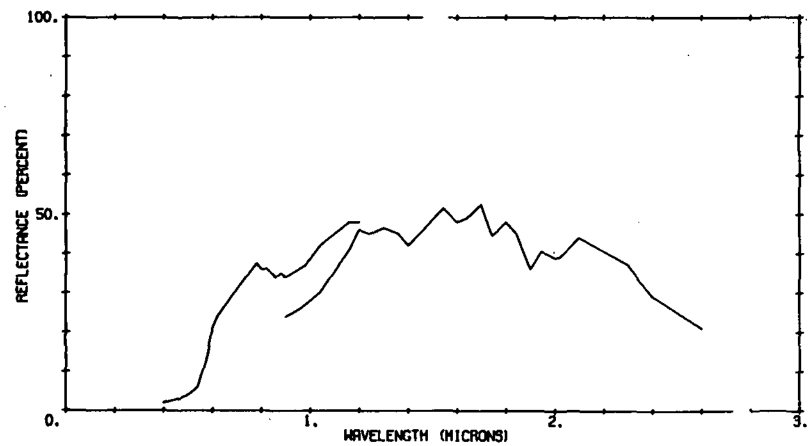
B00830 142

LOAM, COLTS NECK TYPE, NEW JERSEY, WET



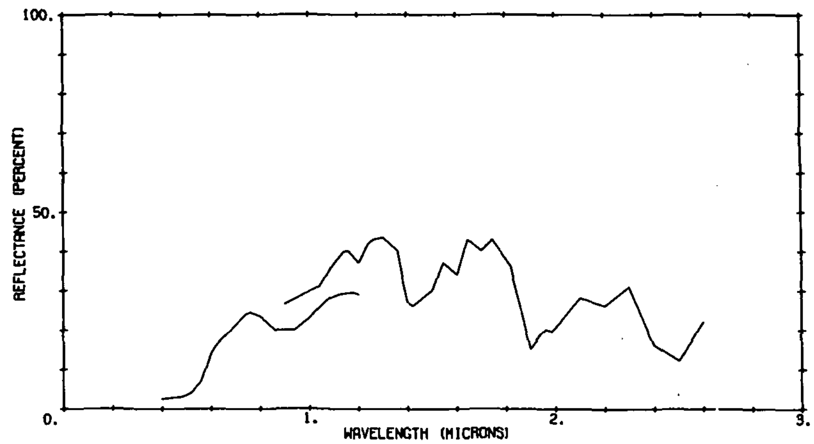
B00830 159

LOAM, GREENVILLE TYPE, LOUISIANA, DRY



B00830 161

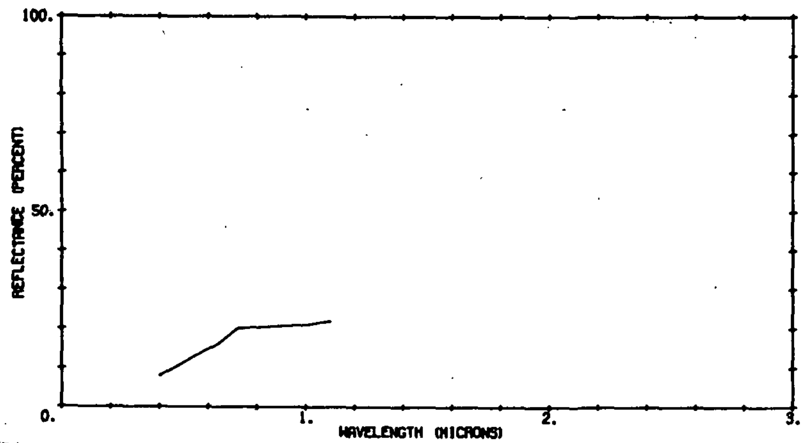
LOAM, GREENVILLE TYPE, LOUISIANA, WET



BFEA 6

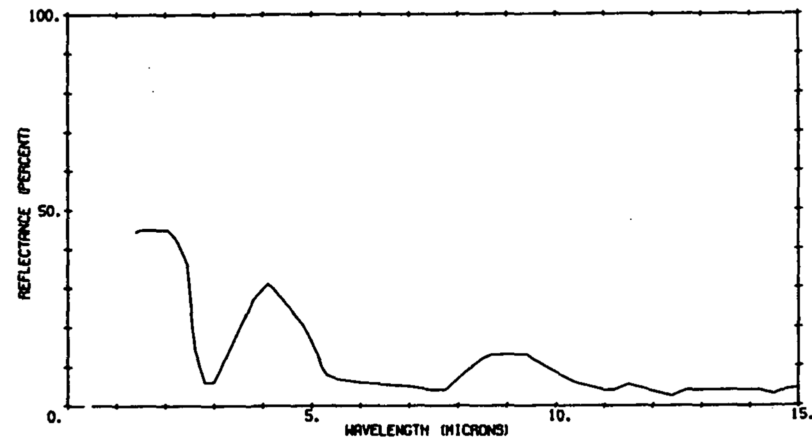
B01176 049

LOAM, DRY



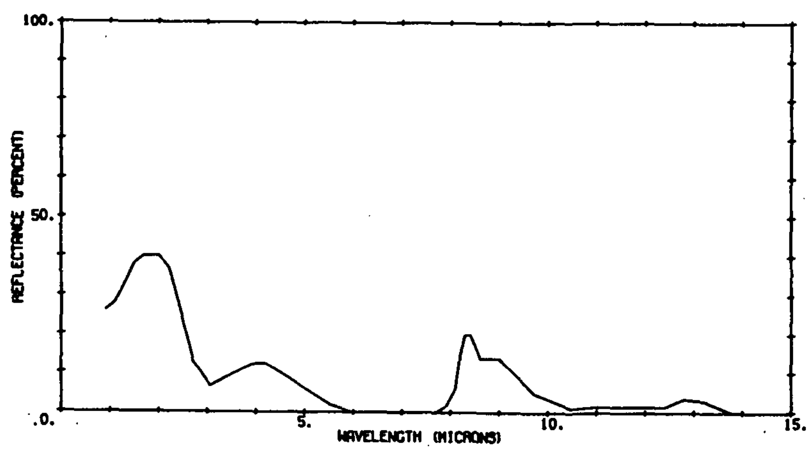
B01818 022

PULMAN LOAM, NEW MEXICO



B01818 024

COLTS NECK LOAM, NEW JERSEY



BFEB

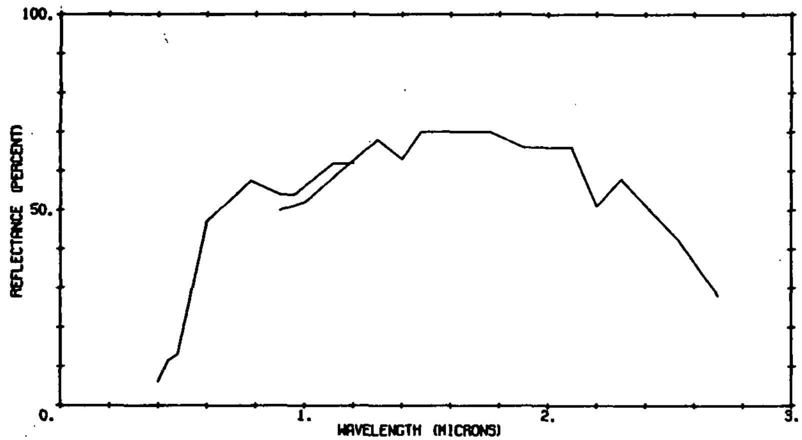
SOIL

Silt Loam

240

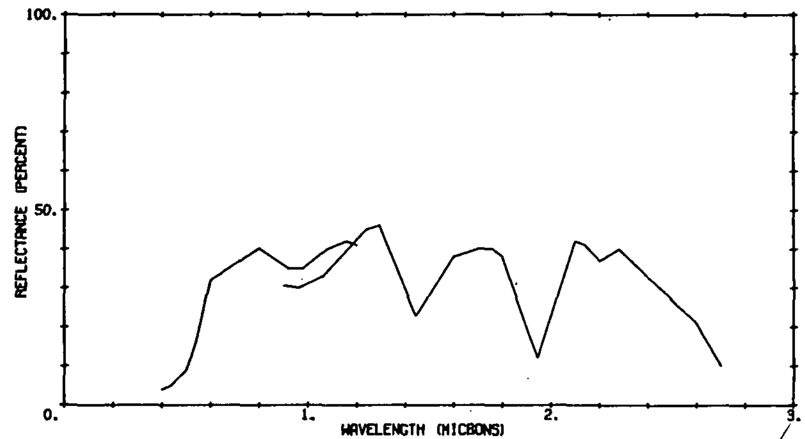
B00830 021

LOAM, DRY HERRADURA PURE SILT, CUBA



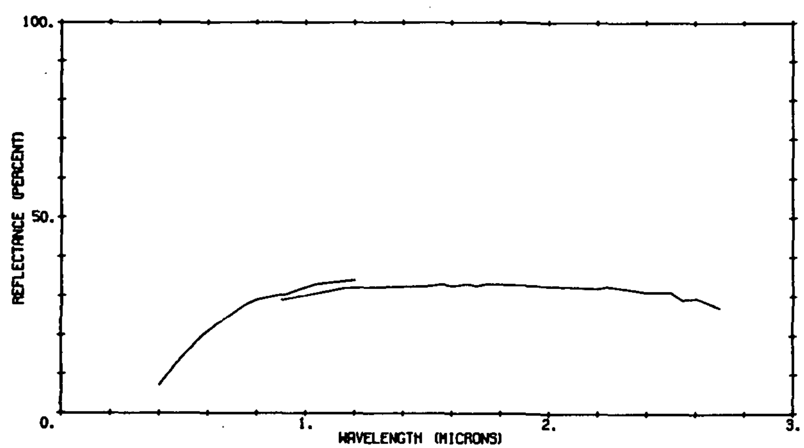
B00830 023

LOAM, WET HERRADURA PURE SILT, CUBA



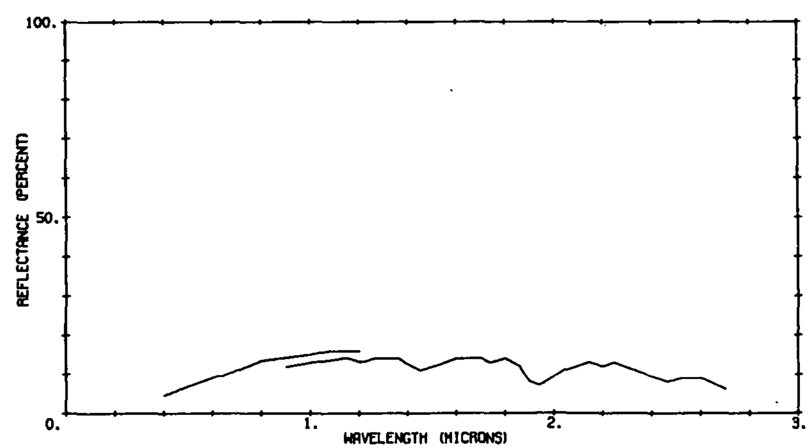
B00830 025

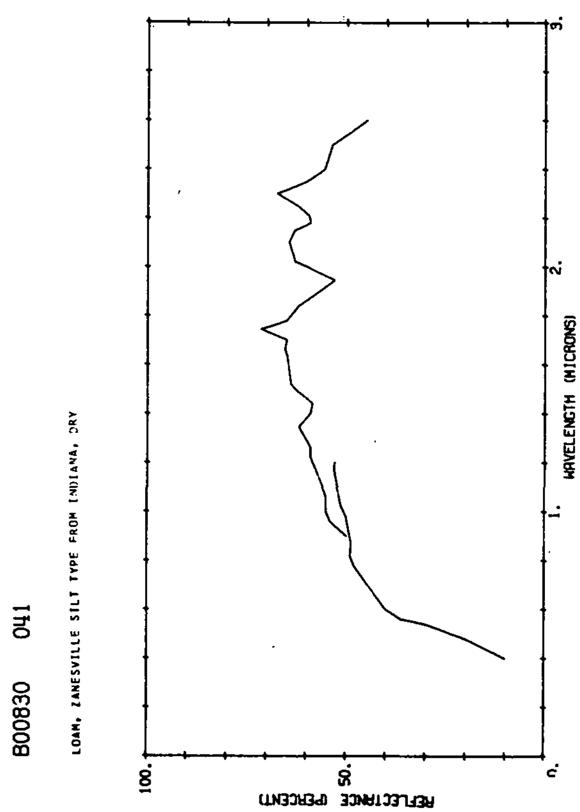
LOAM, DRY AGUAN SILT, CIEBA AREA, HONDURAS

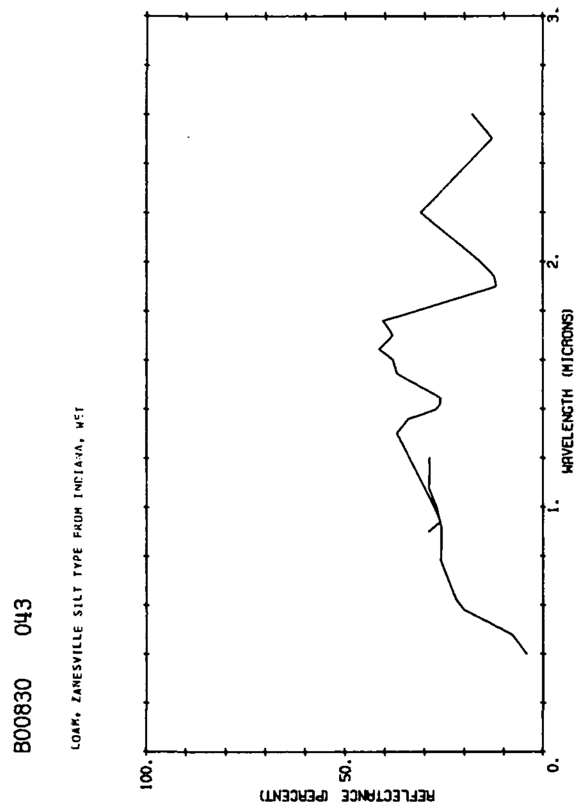


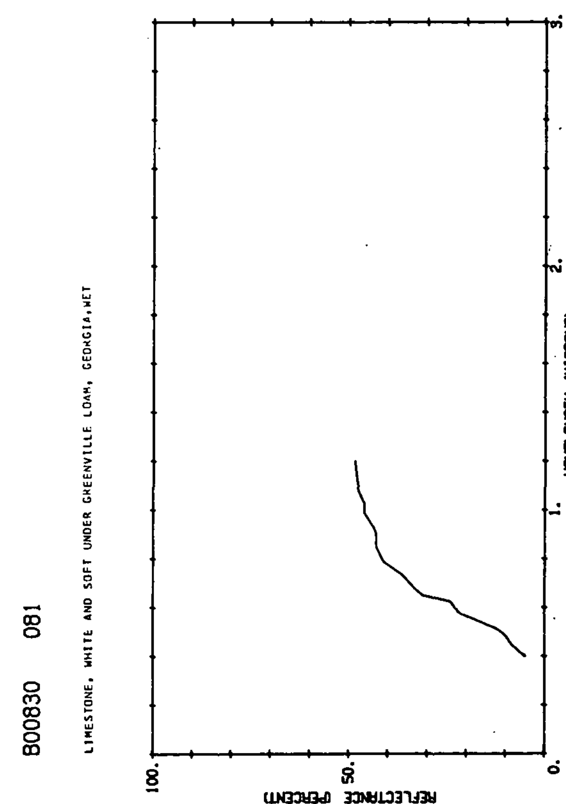
B00830 027

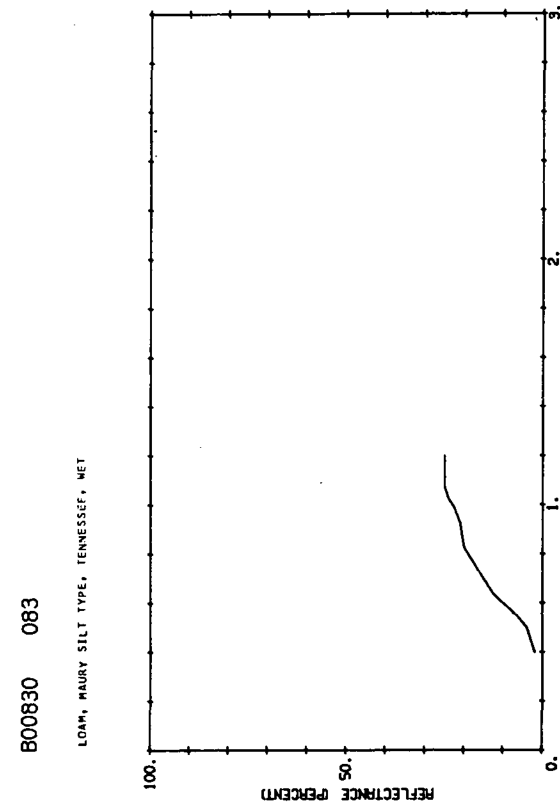
LOAM, WET AGUAN SILT, CIEBA AREA, HONDURAS

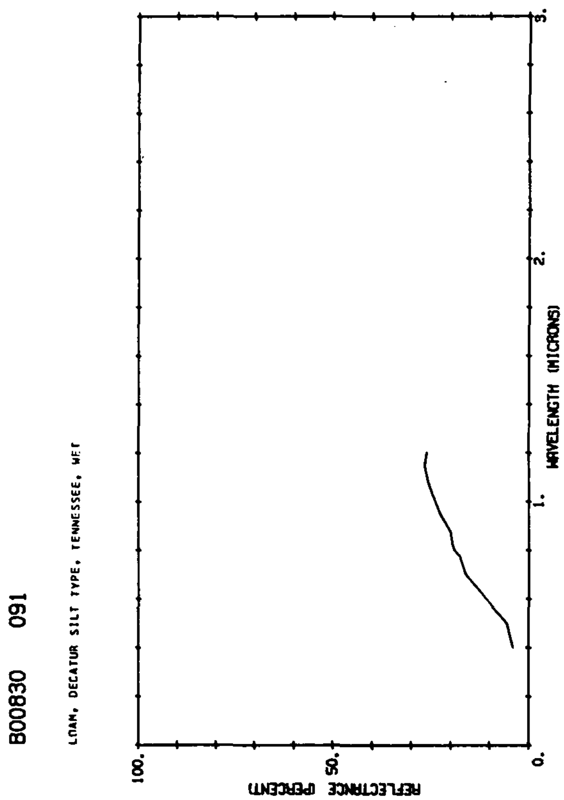


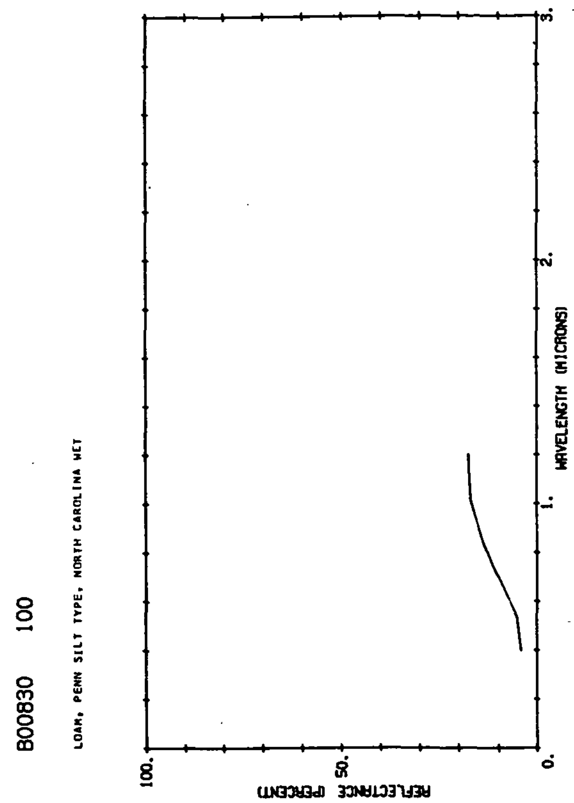

B00830 041
LOAM, ZANESVILLE SILT TYPE FROM INDIANA, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

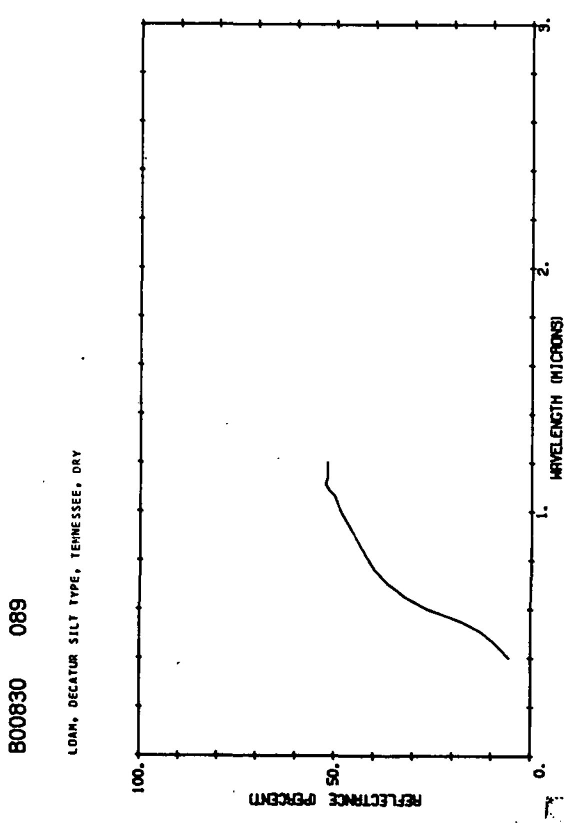

B00830 043
LOAM, ZANESVILLE SILT TYPE FROM INDIANA, WET
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

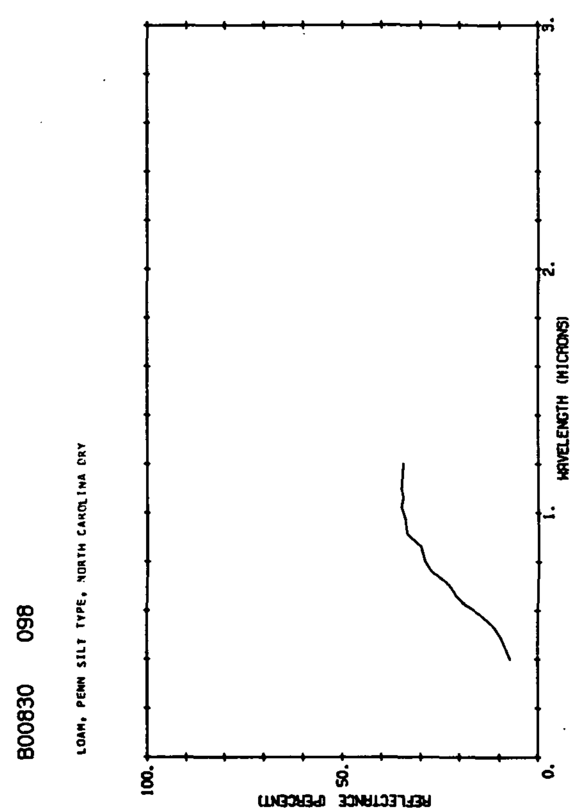

B00830 081
LIMESTONE, WHITE AND SOFT UNDER GREENVILLE LOAM, GEORGIA, WET
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B00830 083
LOAM, MAURY SILT TYPE, TENNESSEE, WET
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B00830 091
LOAM, DECATUR SILT TYPE, TENNESSEE, WET
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

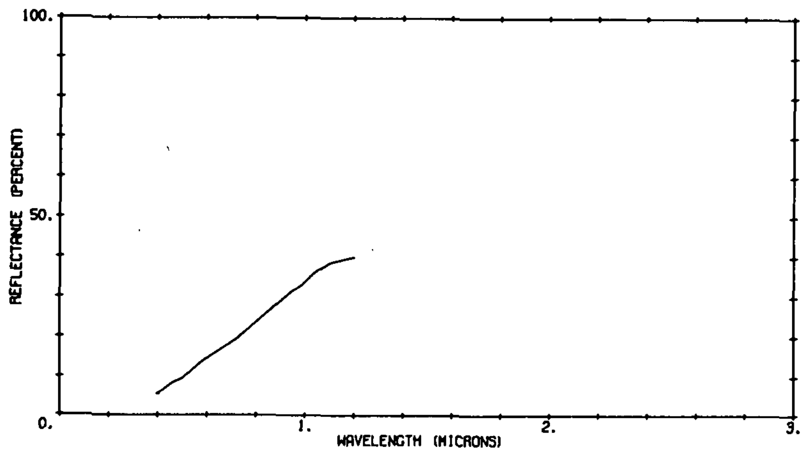

B00830 100
LOAM, PENN SILT TYPE, NORTH CAROLINA WET
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B00830 089
LOAM, DECATUR SILT TYPE, TENNESSEE, DRY
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B00830 098
LOAM, PENN SILT TYPE, NORTH CAROLINA DRY
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

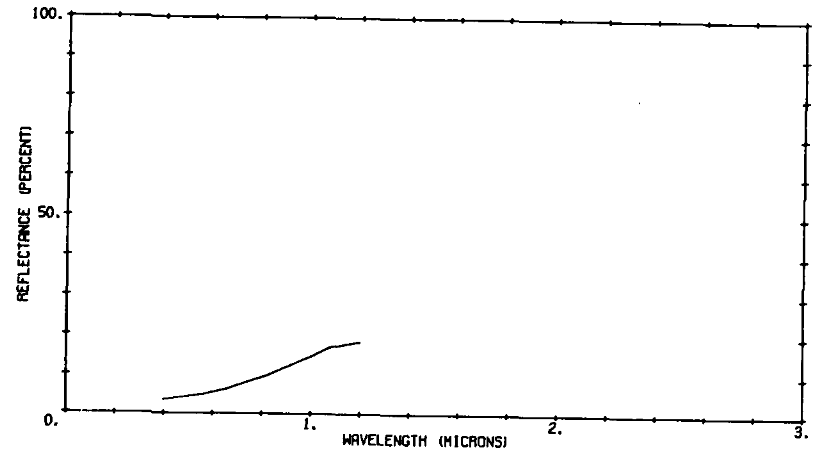
B00830 119

LOAM, MARSHALL SILT TYPE, IOWA, DRY



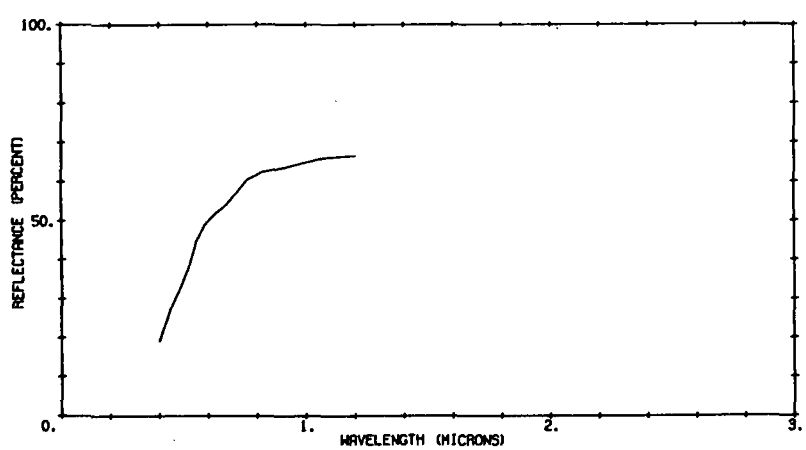
B00830 120

LOAM, MARSHALL SILT TYPE, IOWA, WET



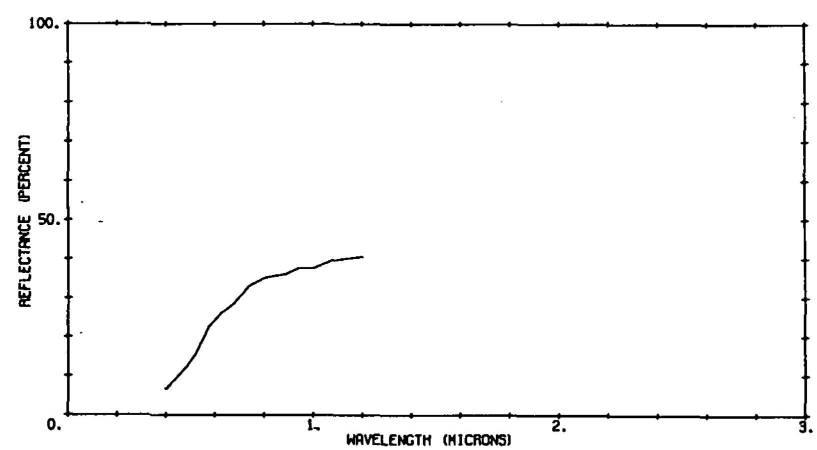
B00830 123

LOAM, ALAMANCE SILT, SOUTH CAROLINA, DRY



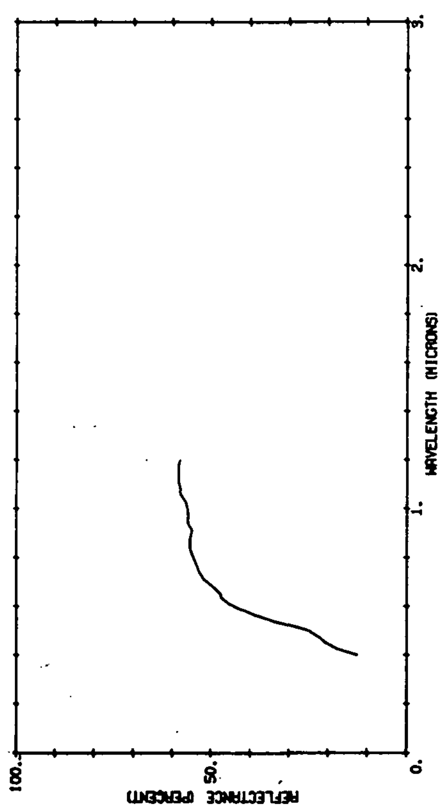
B00830 124

LOAM, ALAMANCE SILT, SOUTH CAROLINA, WET



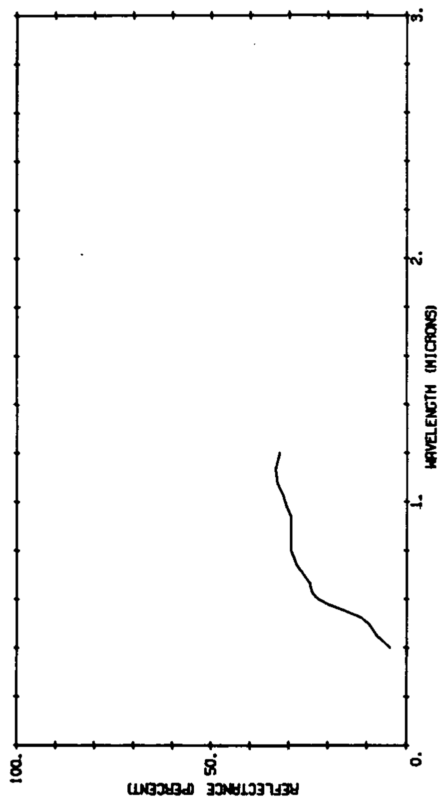
B00830 143

LOAM, TILSIT SILT TYPE, INDIANA, DRY



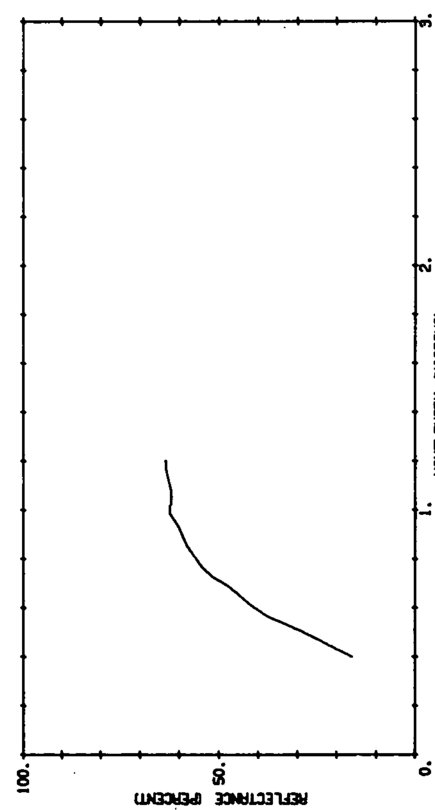
B00830 145

LOAM, TILSIT SILT TYPE, INDIANA, WET



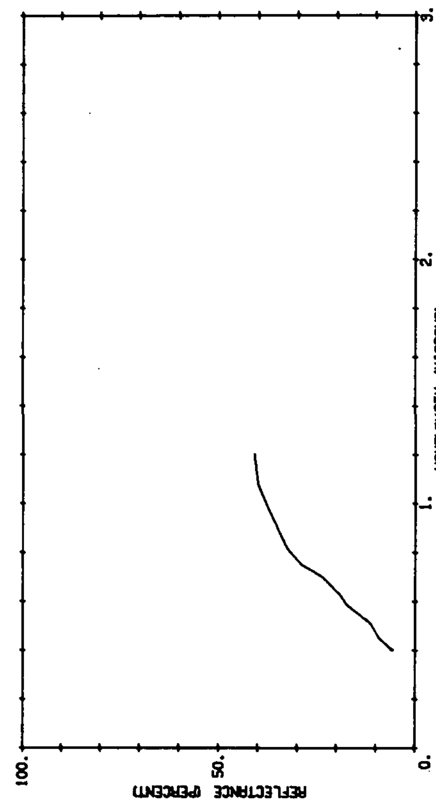
B00830 149

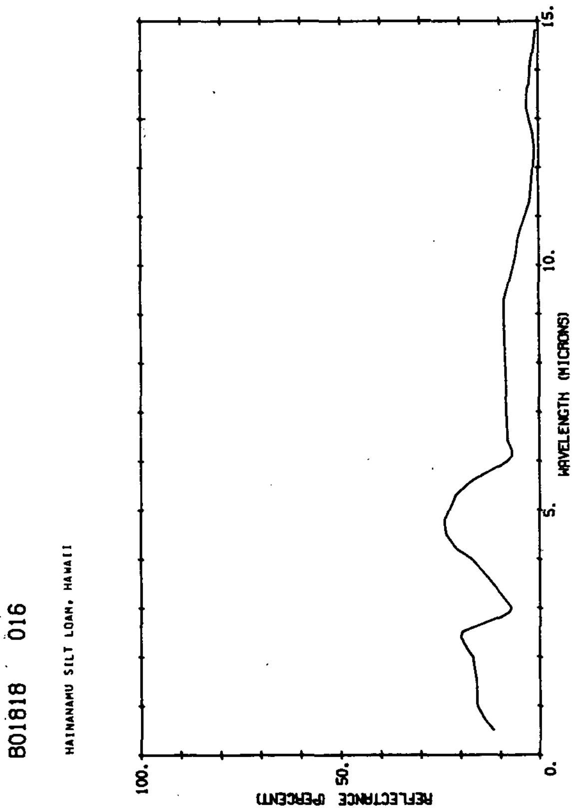
LOAM, GUTHRIE SILT TYPE, KENTUCKY, DRY

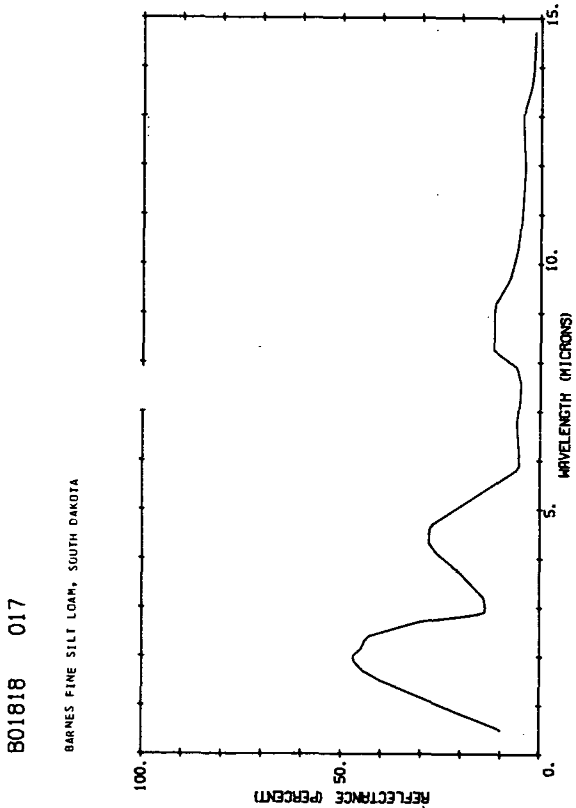


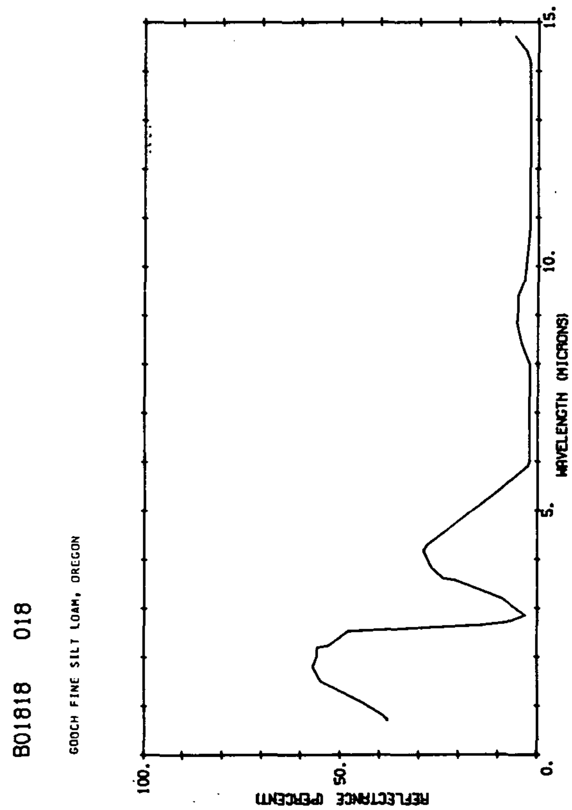
B00830 150

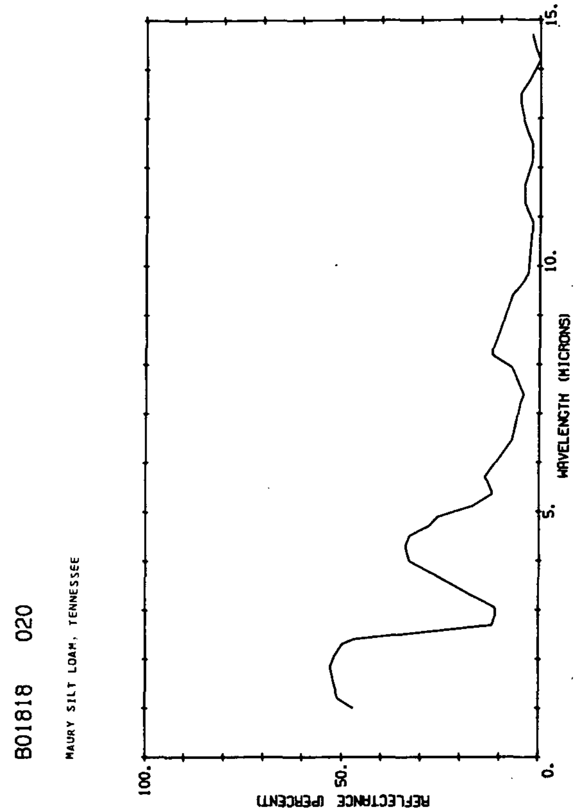
LOAM, GUTHRIE SILT TYPE, KENTUCKY, WET




B01818 016
HAINANAMU SILT LOAM, HAWAII
REFLECTANCE (PERCENT)
100.
50.
0.
5.
10.
15.
WAVELENGTH (MICRONS)

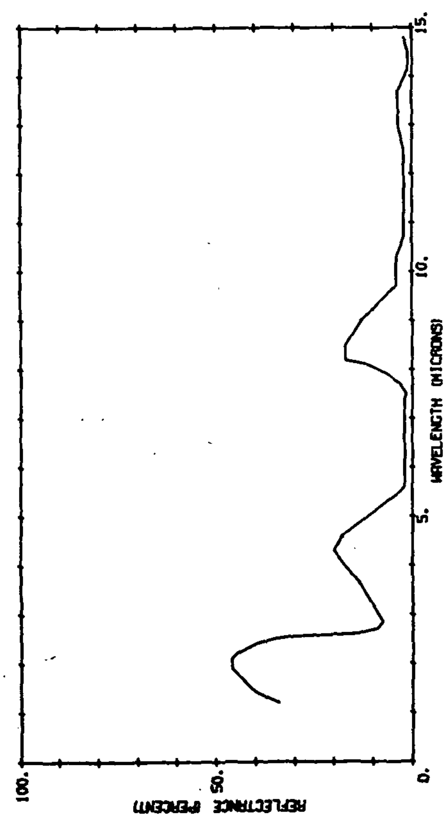

B01818 017
BARNES FINE SILT LOAM, SOUTH DAKOTA
REFLECTANCE (PERCENT)
100.
50.
0.
5.
10.
15.
WAVELENGTH (MICRONS)


B01818 018
GOOCH FINE SILT LOAM, OREGON
REFLECTANCE (PERCENT)
100.
50.
0.
5.
10.
15.
WAVELENGTH (MICRONS)


B01818 020
MAURY SILT LOAM, TENNESSEE
REFLECTANCE (PERCENT)
100.
50.
0.
5.
10.
15.
WAVELENGTH (MICRONS)

801818 023

GRADY SILT LOAM, GEORGIA



BFFA

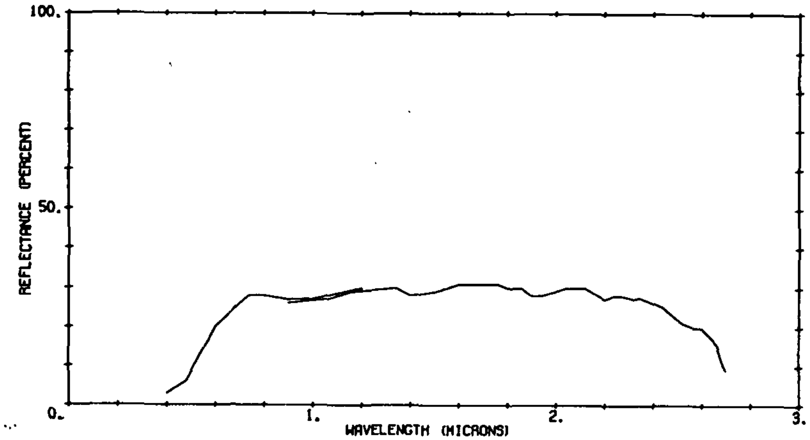
SOIL

Clay Loam

248

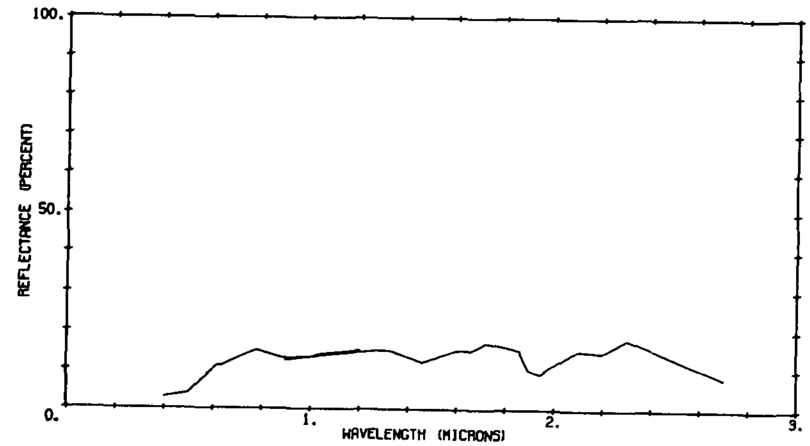
B00830 029

LOAM, DRY AIKEN CLAY, OREGON



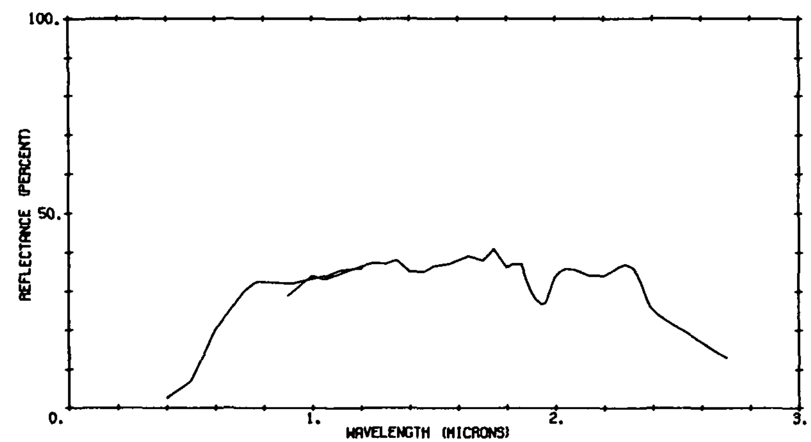
B00830 031

LOAM, WET AIKEN CLAY, OREGON



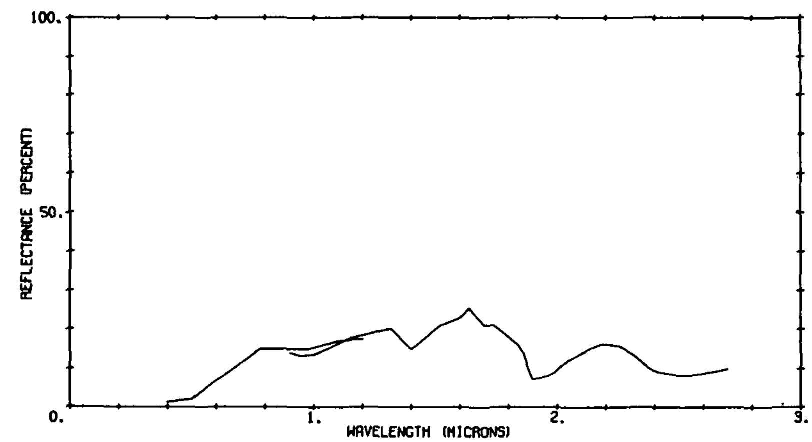
B00830 037

LOAM, MOAULA LIGHT CLAY TYPE, DRY



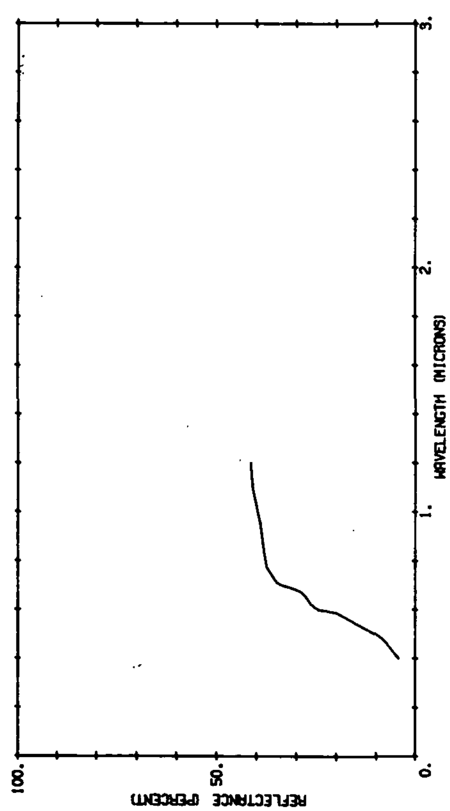
B00830 039

LOAM, MOAULA LIGHT CLAY TYPE, WET



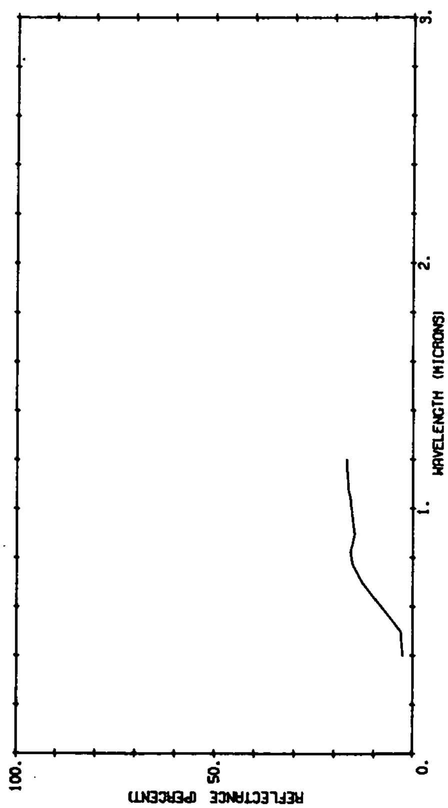
B00830 / 061

LOAM, NAALEHU HEAVY CLAY TYPE FROM HAWAIIAN ISLANDS, DRY



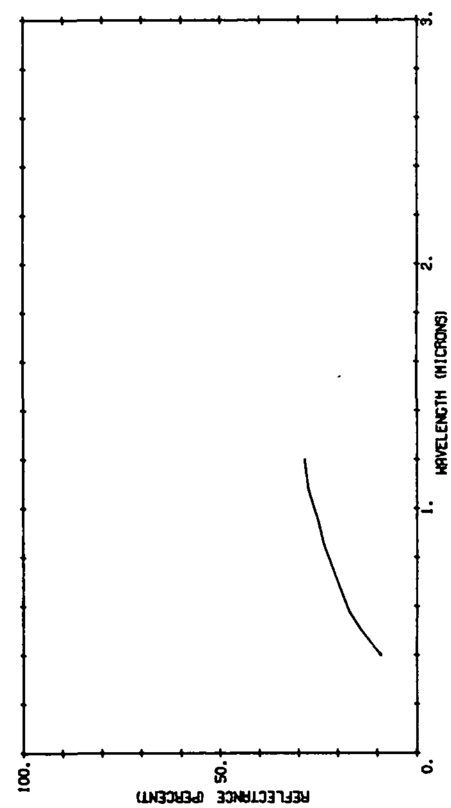
B00830 063

LOAM, NAALEHU HEAVY CLAY TYPE FROM HAWAIIAN ISLANDS, WET



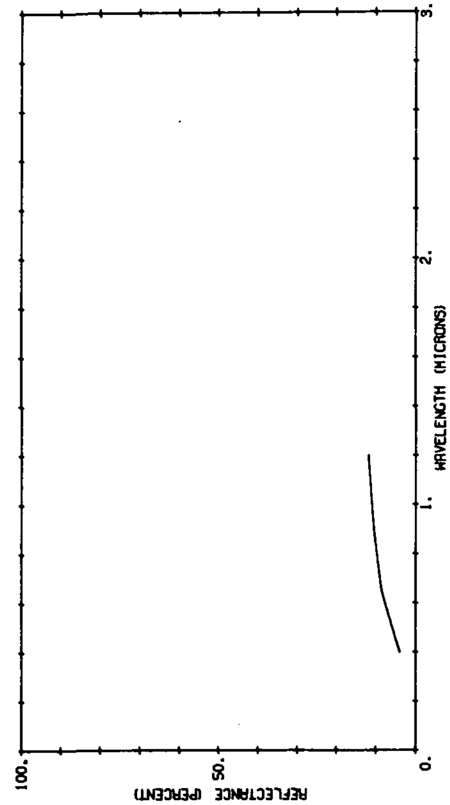
B00830 071

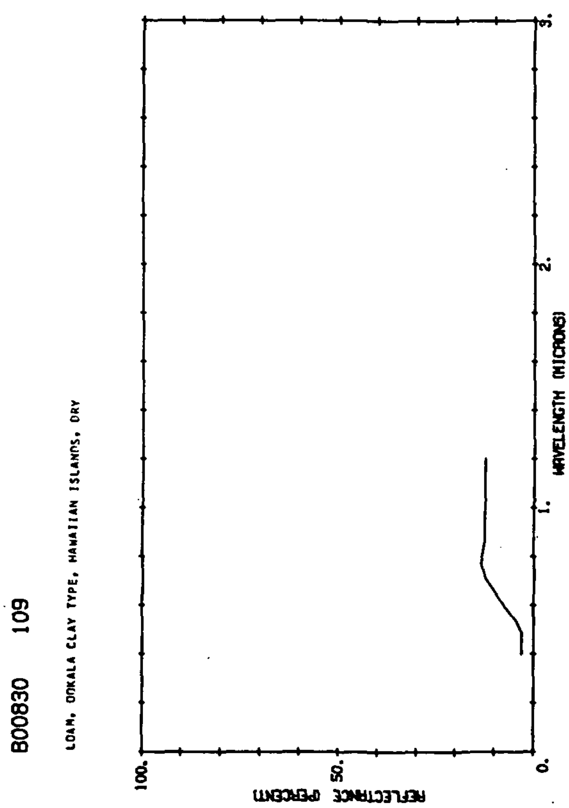
LOAM, PIERRE CLAY TYPE, WYOMING, DRY

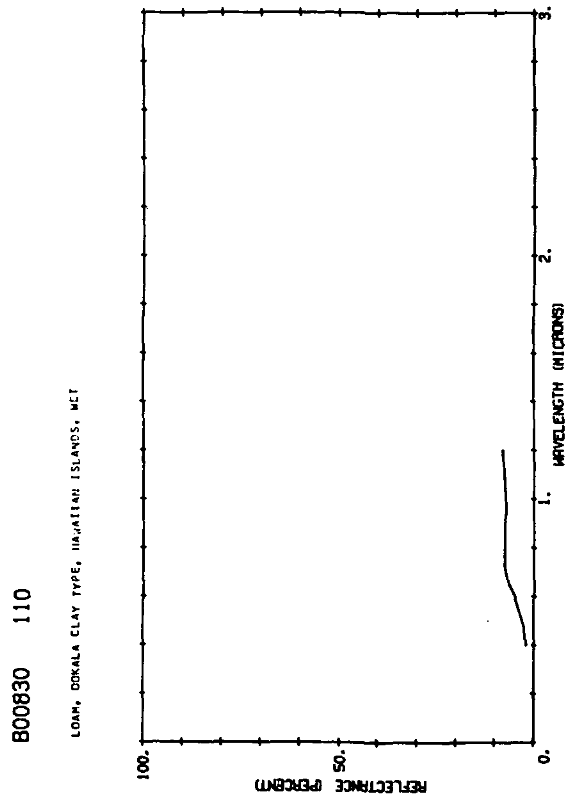


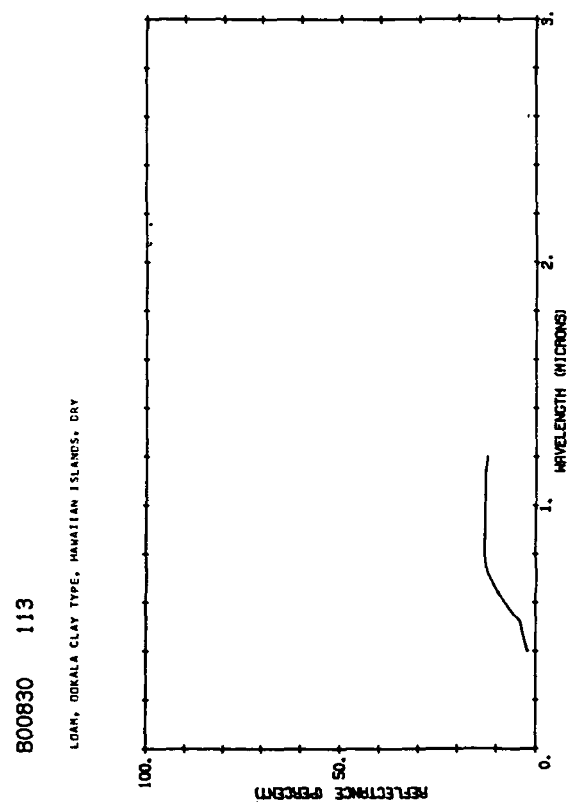
B00830 072

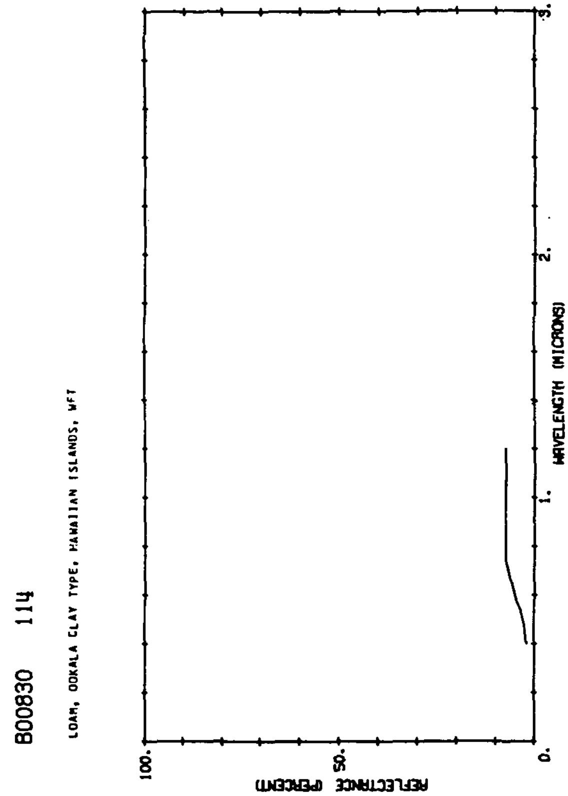
LOAM, PIERRE CLAY TYPE, WYOMING, WET

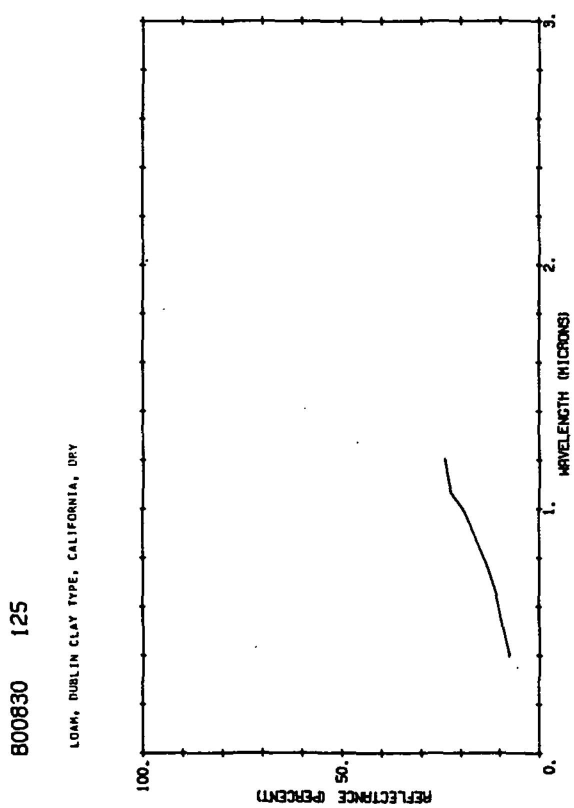


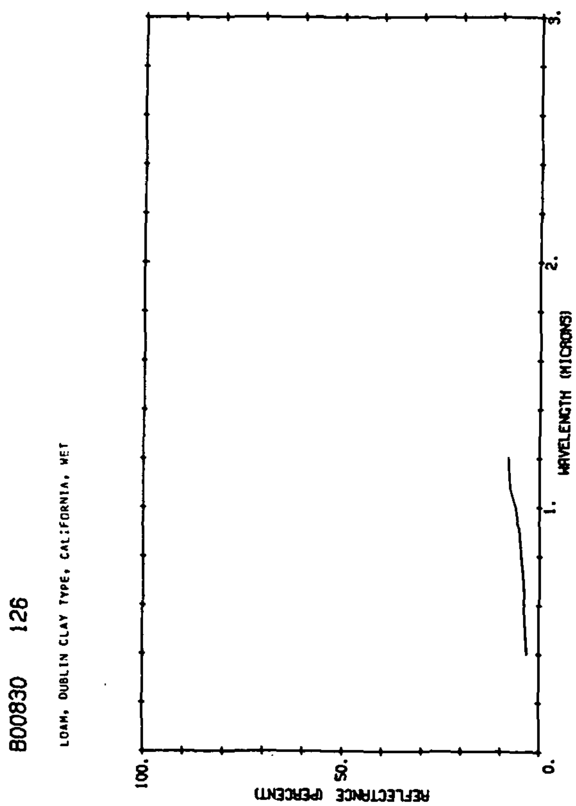

B00830 109
LOAM, OOKALA CLAY TYPE, HAWAIIAN ISLANDS, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

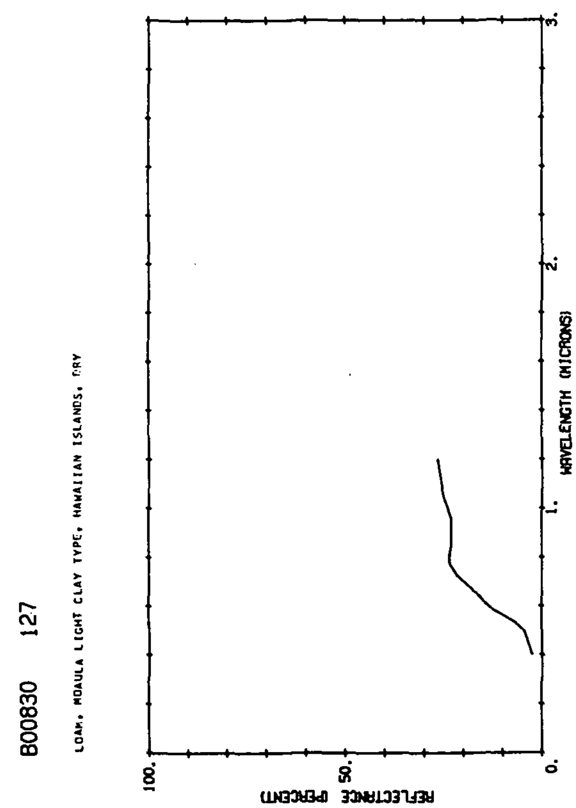

B00830 110
LOAM, OOKALA CLAY TYPE, HAWAIIAN ISLANDS, WET
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

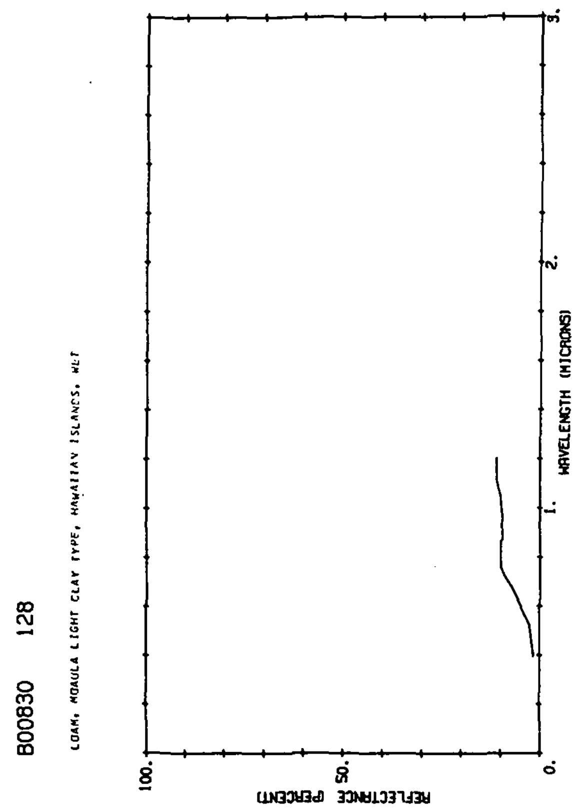

B00830 113
LOAM, OOKALA CLAY TYPE, HAWAIIAN ISLANDS, DRY
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B00830 114
LOAM, OOKALA CLAY TYPE, HAWAIIAN ISLANDS, WET
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B00830 125
LOAM, DUBLIN CLAY TYPE, CALIFORNIA, DRY
REFLECTANCE (PERCENT)
0.
50.
100.
WAVELENGTH (MICRONS)
1.
2.
3.

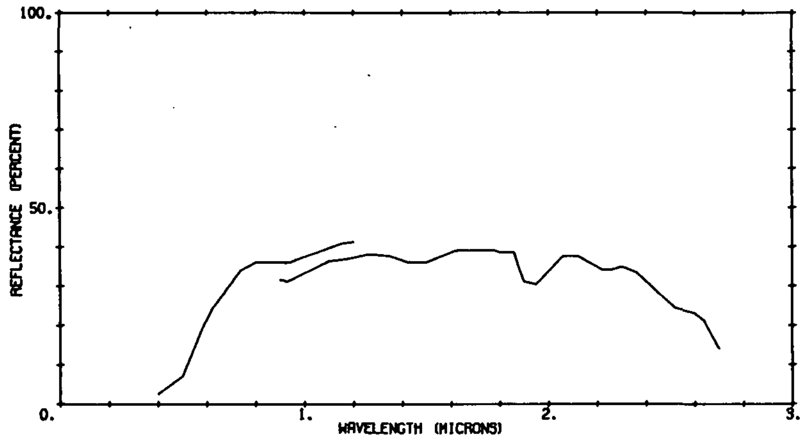

B00830 126
LOAM, DUBLIN CLAY TYPE, CALIFORNIA, WET
REFLECTANCE (PERCENT)
0.
50.
100.
WAVELENGTH (MICRONS)
1.
2.
3.


B00830 127
LOAM, MOAULA LIGHT CLAY TYPE, HAWAIIAN ISLANDS, DRY
REFLECTANCE (PERCENT)
0.
50.
100.
WAVELENGTH (MICRONS)
1.
2.
3.


B00830 128
LOAM, MOAULA LIGHT CLAY TYPE, HAWAIIAN ISLANDS, WET
REFLECTANCE (PERCENT)
0.
50.
100.
WAVELENGTH (MICRONS)
1.
2.
3.

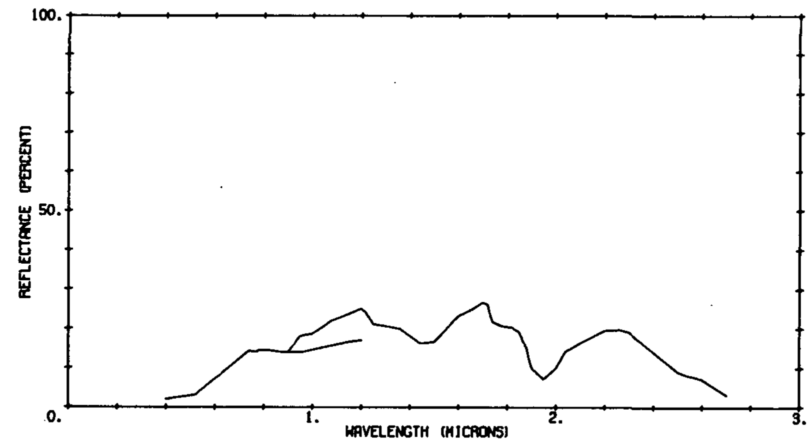
B00830 151

LOAM, NAALEHU HEAVY CLAY TYPE, HAWAIIAN ISLANDS, DRY



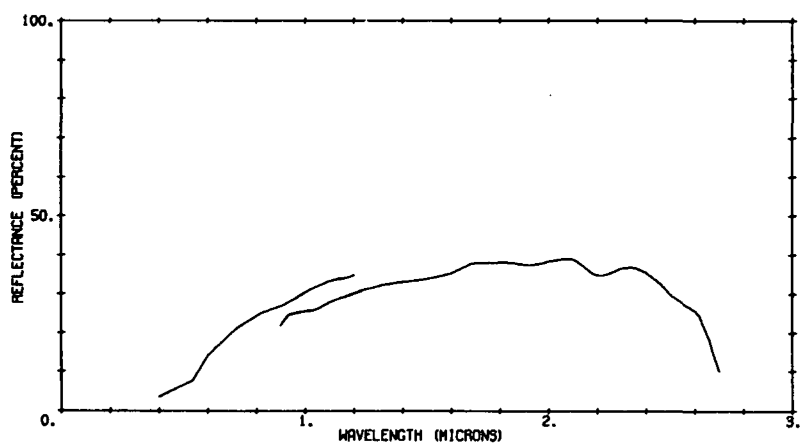
B00830 153

LOAM, NAALEHU HEAVY CLAY TYPE, HAWAIIAN ISLANDS, WET



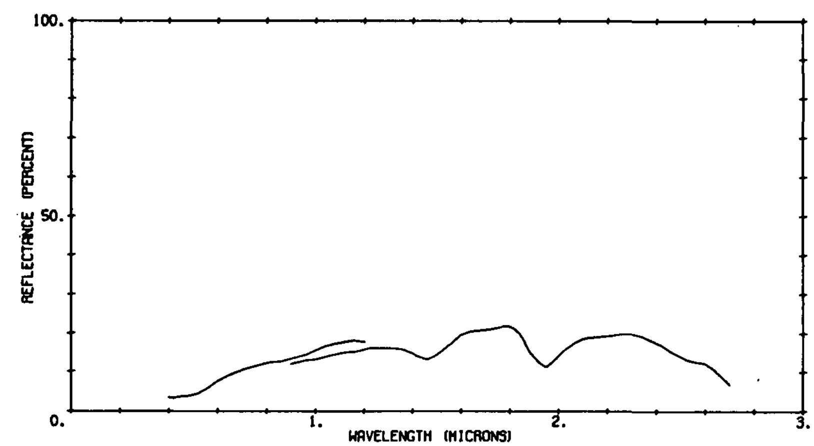
B00830 183

LOAM, BLAKELY CLAY TYPE, GEORGIA, DRY



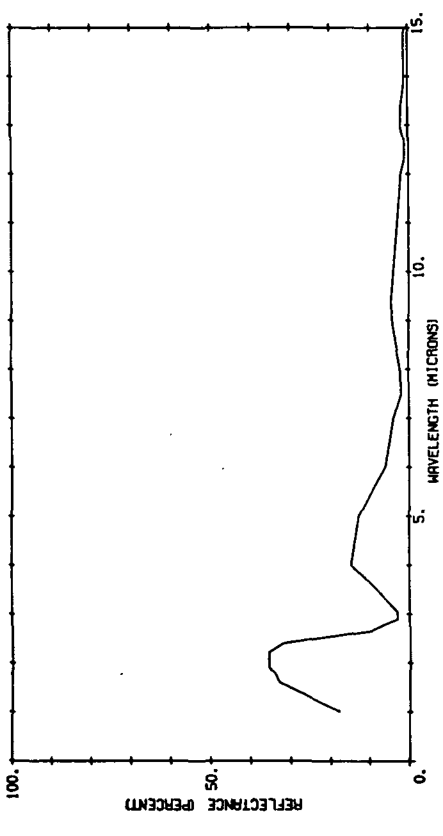
B00830 185

LOAM, BLAKELY CLAY TYPE, GEORGIA, WET



B01818 021

DUBLIN CLAY LOAM, CALIFORNIA



BFGC

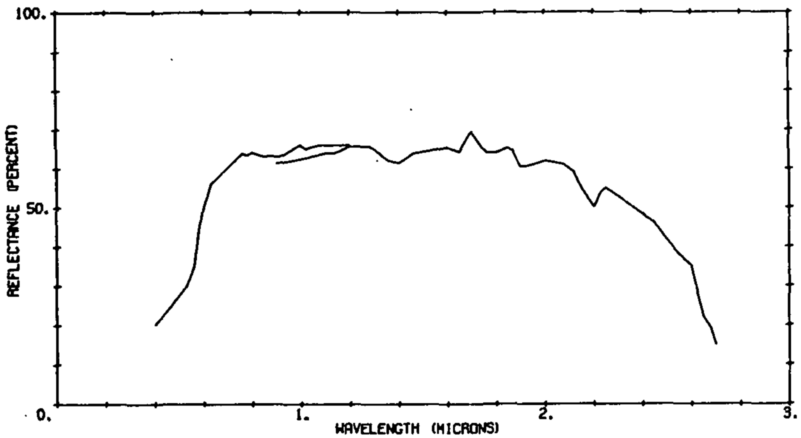
SOIL

Clay

255

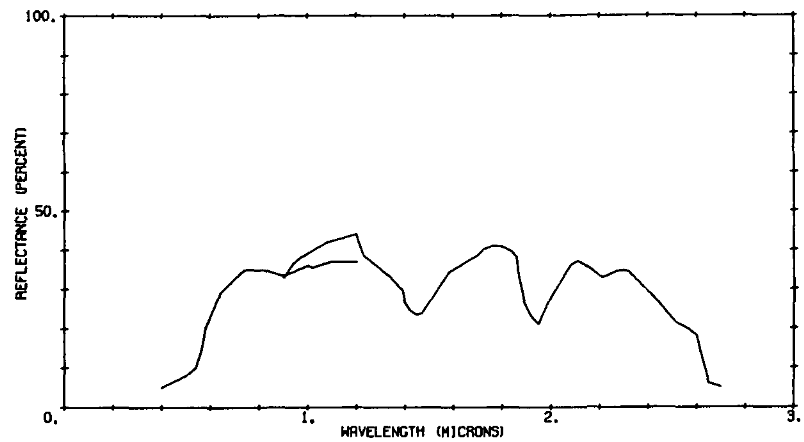
B00830 001

CLAY, QUIBDO GRAVELLY, DRY



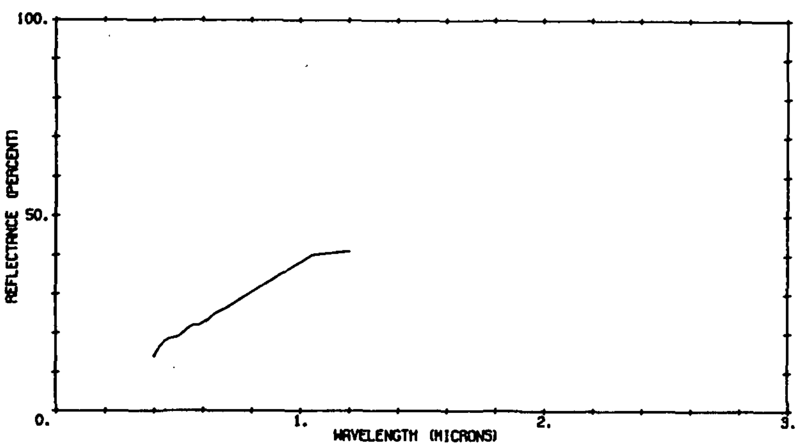
B00830 003

CLAY, QUIBDO GRAVELLY, WET



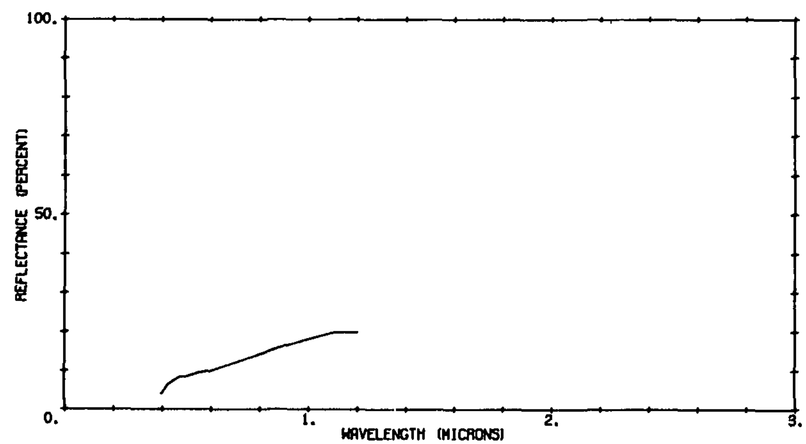
B00830 097

CLAY, ORMAN TYPE, NORTH CAROLINA, DRY



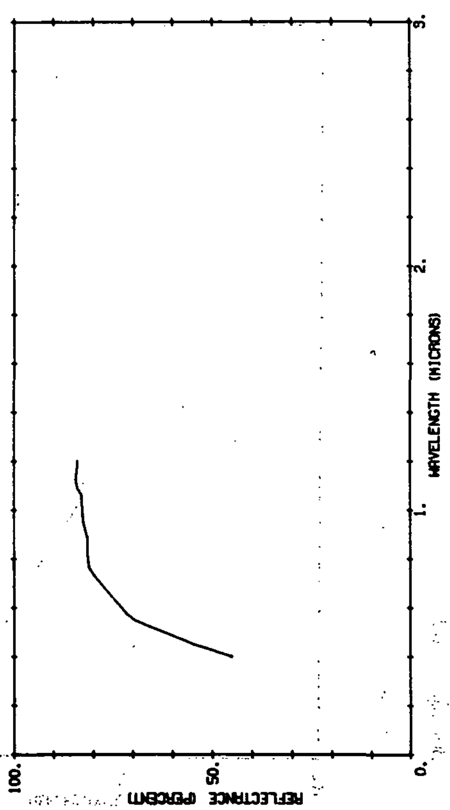
B00830 099

CLAY, ORMAN TYPE, NORTH CAROLINA, WET



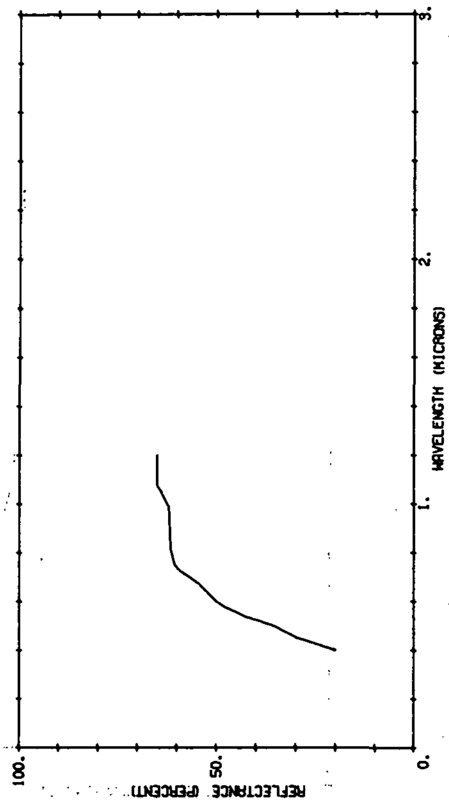
B00830 101

CLAY, ORIENTE TYPE, CUBA, DRY



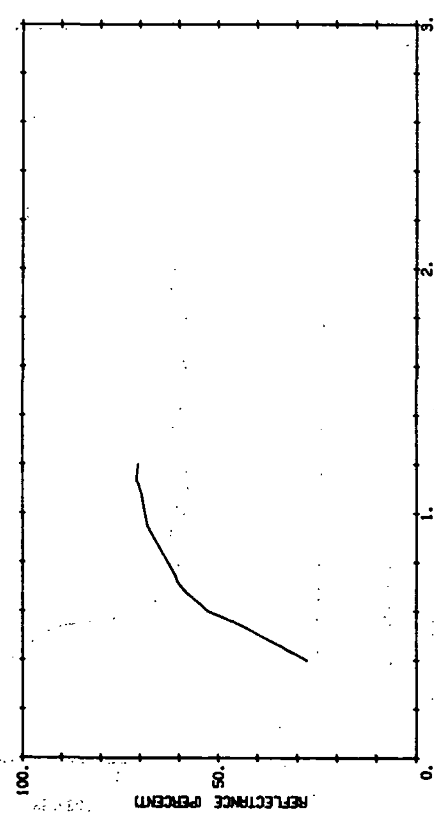
B00830 102

CLAY, ORIENTE TYPE, CUBA, WET



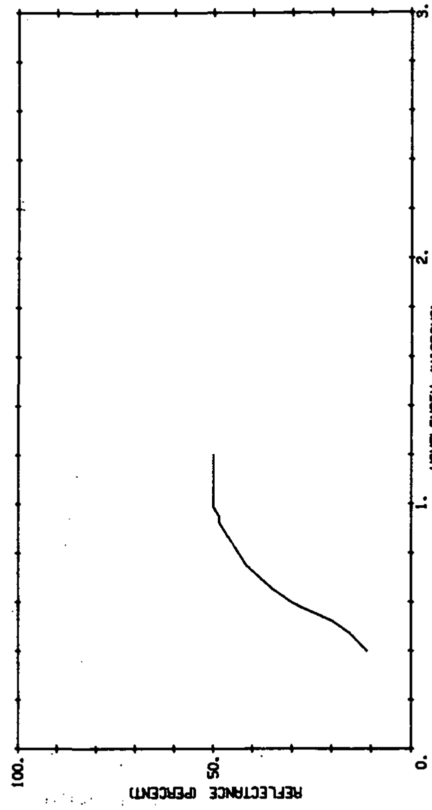
B00830 105

LOAM, CLAREVILLE CLAY TYPE, TEXAS, DRY



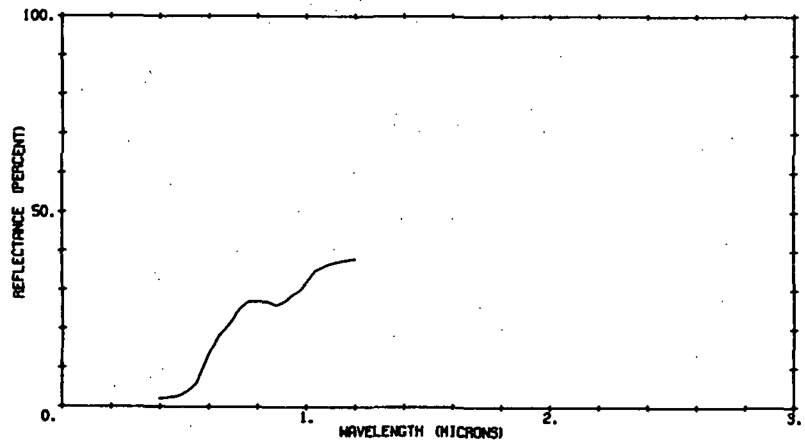
B00830 106

LOAM, CLAREVILLE CLAY TYPE, TEXAS, WET



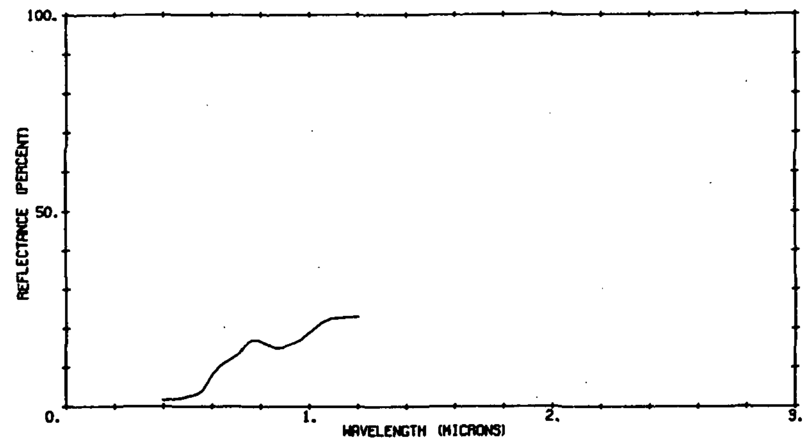
B00830 117

CLAY, MATANZAS TYPE, CUBA, DRY



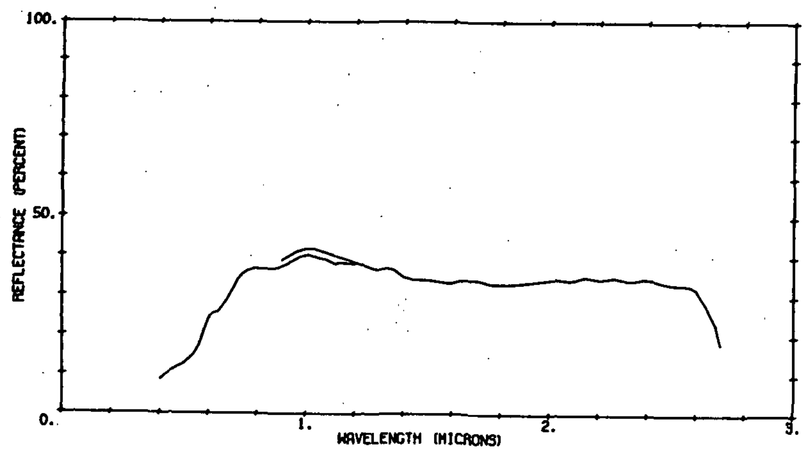
B00830 118

CLAY, MATANZAS TYPE, CUBA, WET



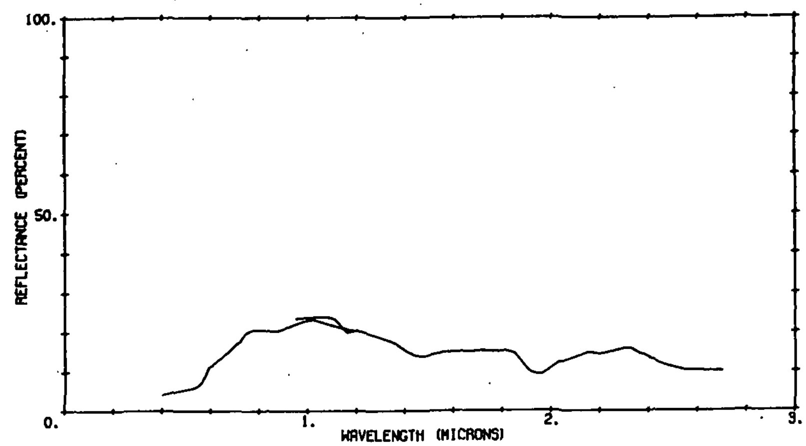
B00830 203

CLAY, ALONSO TYPE, PUERTO RICO, DRY



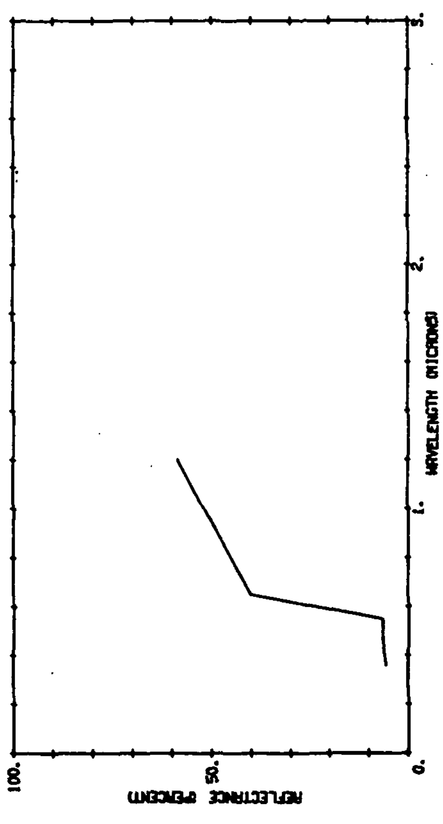
B00830 205

CLAY, ALONSO TYPE, PUERTO RICO, WET



B13946 015

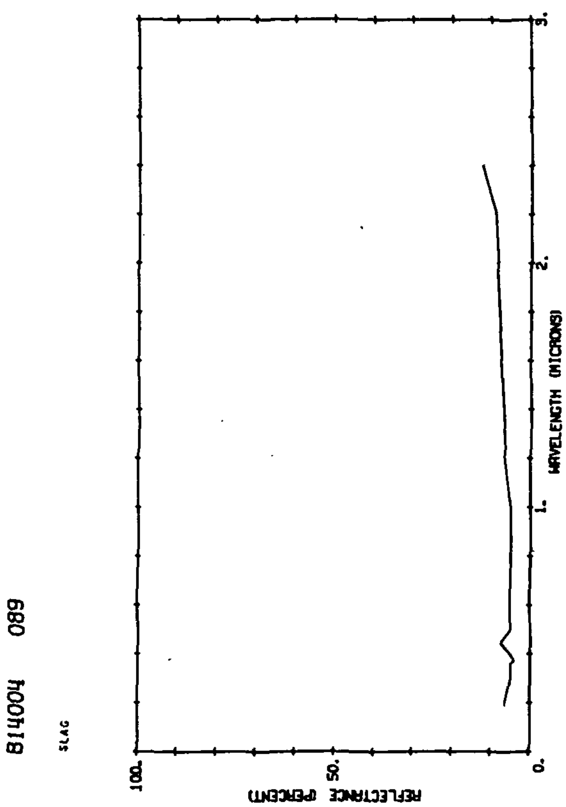
RED CLAY SOIL, DRY.



BFH

SOIL

Other Constituents


814004 089
SLAG
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

BFHD

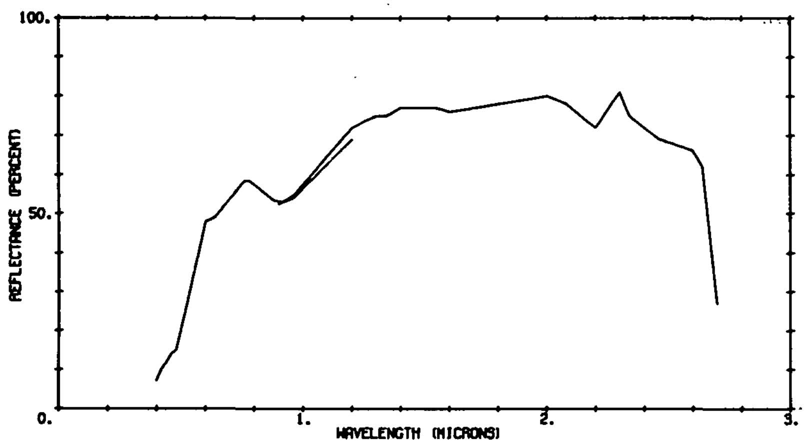
SOIL

Stones (greater than 10-in. diameter)

262

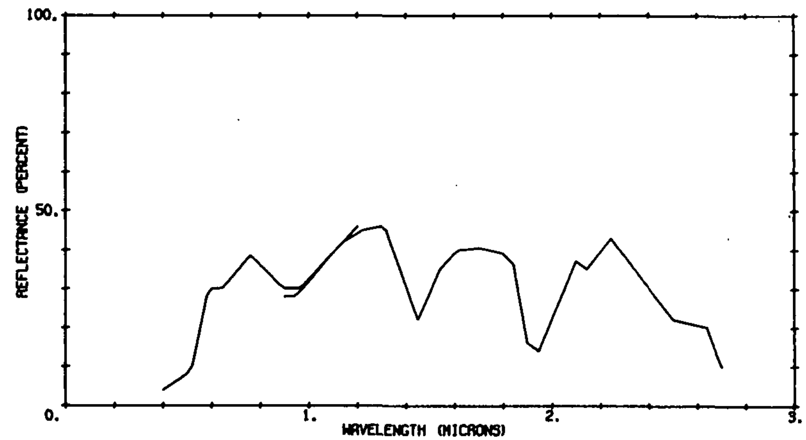
B00830 167

ROCK-NEAR BOTTOM OF BLUFF, TRIKEDADAITO, DRY



B00830 169

ROCK-NEAR BOTTOM OF BLUFF, TRIHEDADAITO, WET



BFK

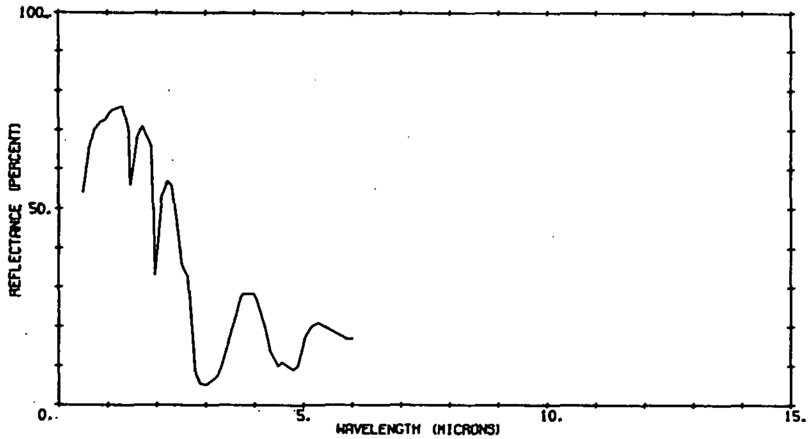
SOIL

Minerals

264

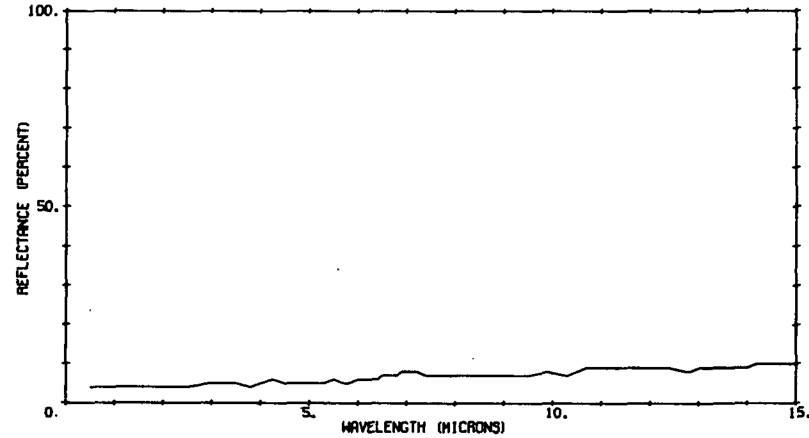
B04804 015

SALT POOL, DEATH VALLEY.



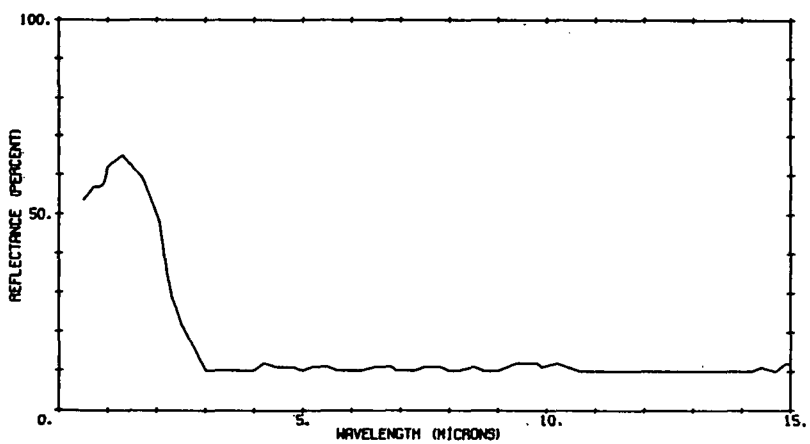
B04979 074

GRAPHITE DUSTED ON SODIUM SILICATE 16 MIL ON POLISHED ALUMIN UM.



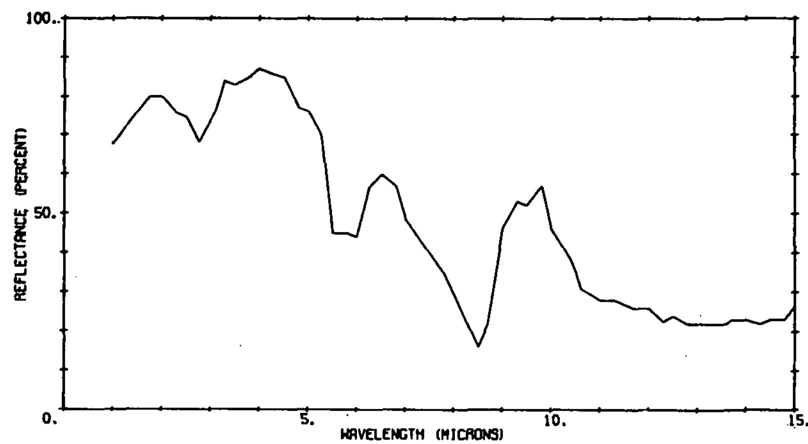
B04979 077

FLUORITE DUSTED ON SODIUM SILICATE 12 MIL ON POLISHED ALUMIN UM.



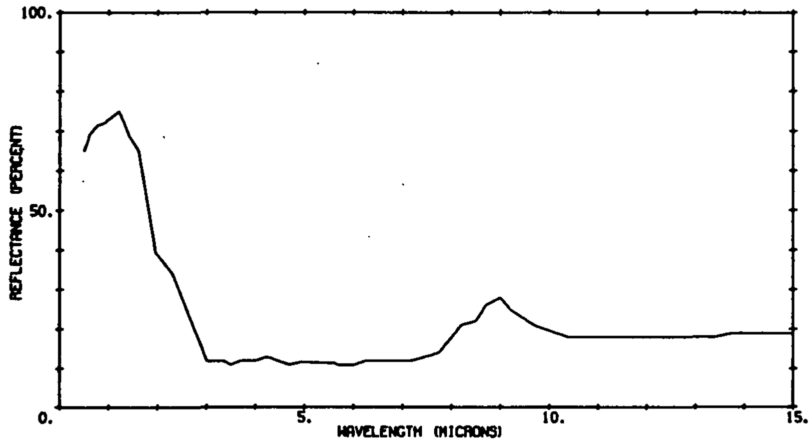
B04979 082

MICA, 1.5 MIL ON POLISHED ALUMINUM.



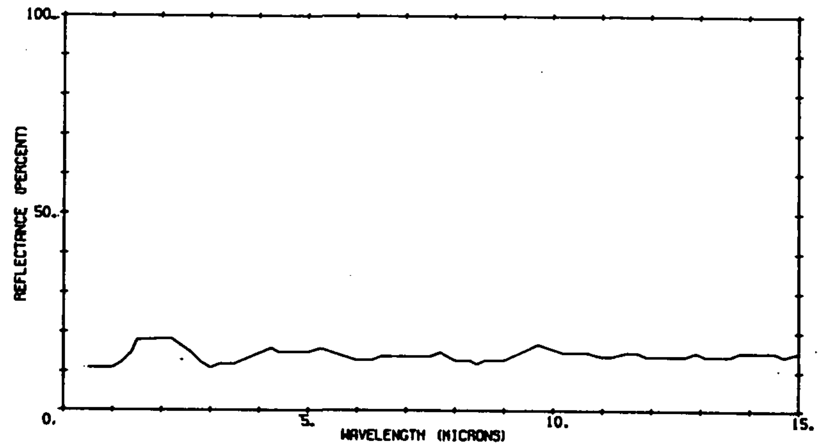
B04979 085

QUARTZ DUSTED ON SODIUM SILICATE, 3[illegible] MIL ON POLISHED ALUMINUM.



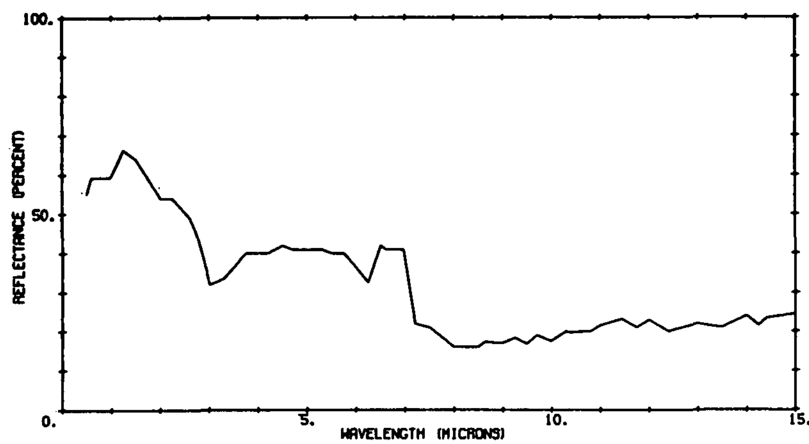
B04979 086

PYRITE DUSTED ON SODIUM SILICATE ON POLISHED ALUMINUM.



B04979 089

SULFUR DUSTED ON SODIUM SILICATE 1[illegible] MIL.



BFL

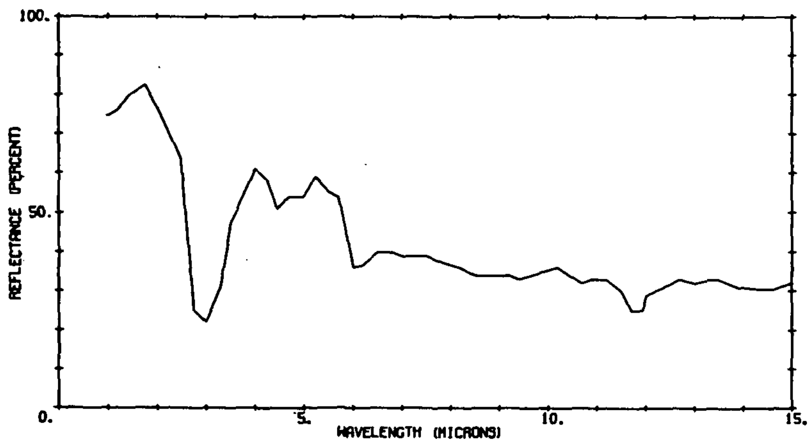
SOIL

Chemicals

267

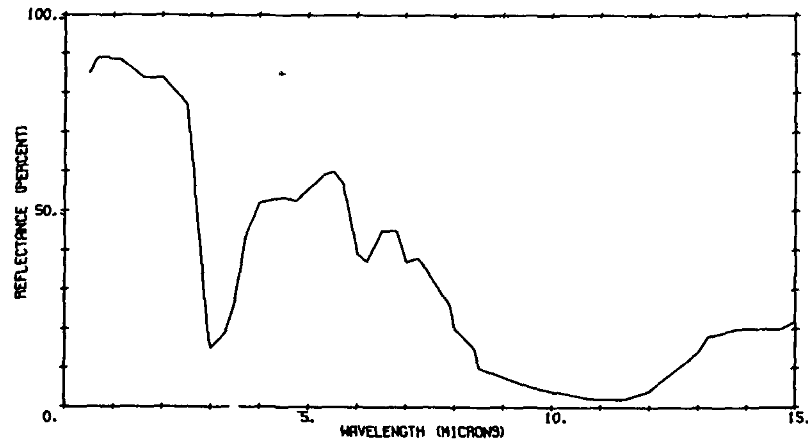
B04979 088

THO(2), POWDERED, ON POLISHED ALUMINUM.



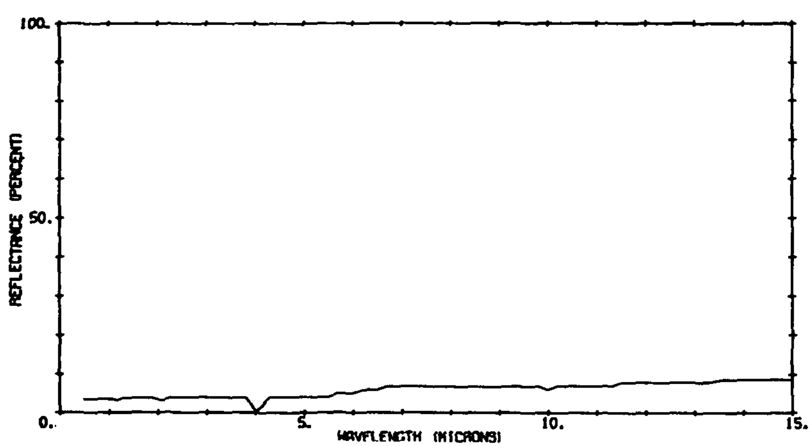
B04979 091

TITANOX-RA, 2 MIL, MIXED WITH WATER ON POLISHED ALUMINUM.



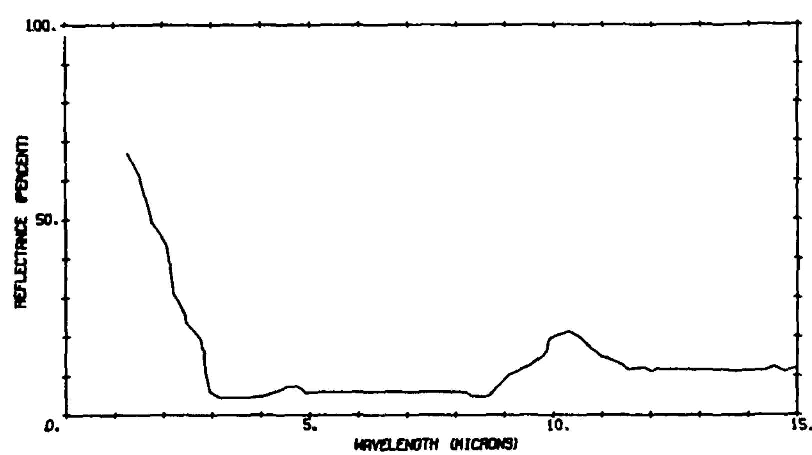
B04979 099

CARBON BLACK, SODIUM SILICATE, POWDERED GLASS 13 MIL ON ALUMINUM.



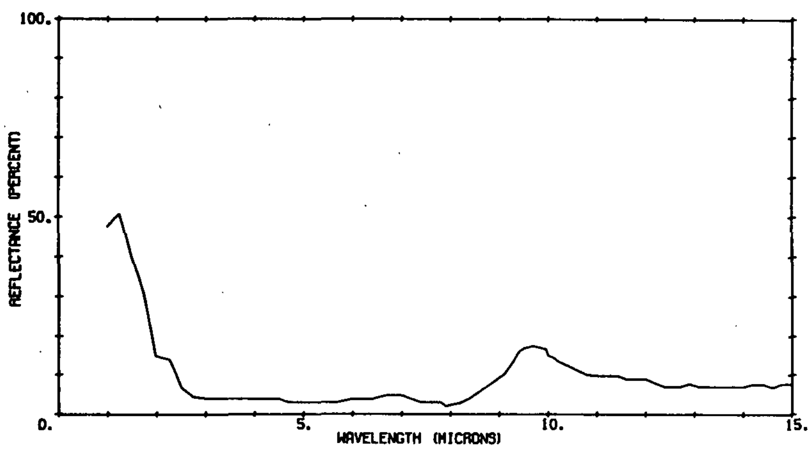
B04979 112

SODIUM SILICATE, 3 MIL ON POLISHED ALUMINUM.



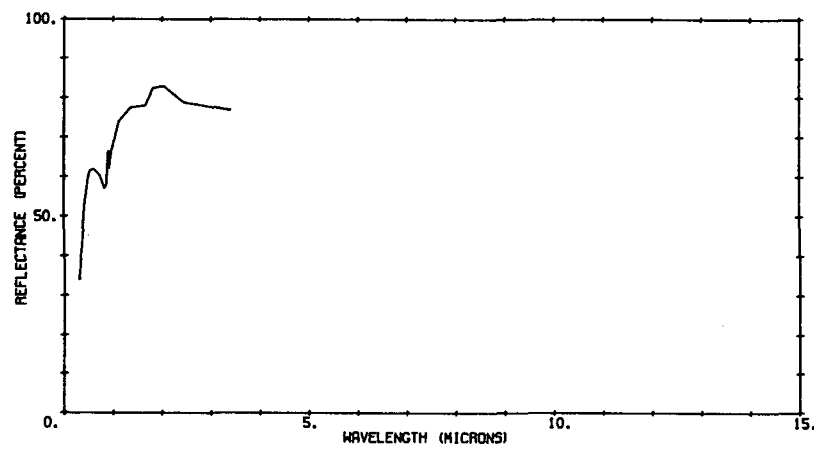
B04979   113

SODIUM SILICATE, MIXED WITH POWDERED GLASS, 9 MIL ON POLISH
ED ALUMINUM.



B04979   123

ANODIZED ALUMINUM, SULFURIC ACID ANODIZE.



BFL 2

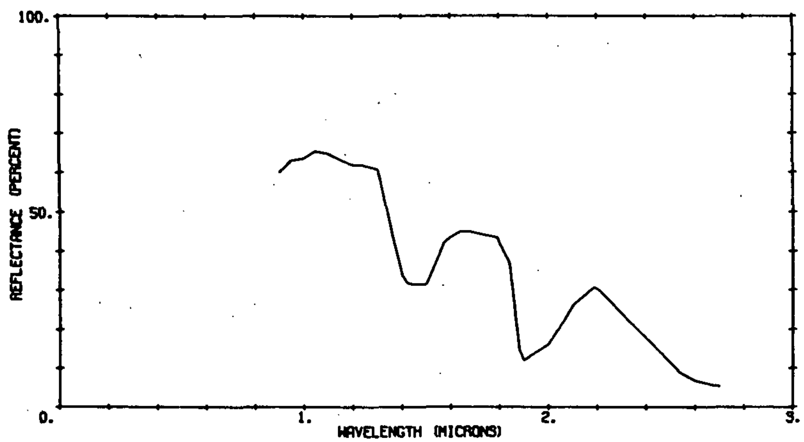
BG

VEGETATION

270

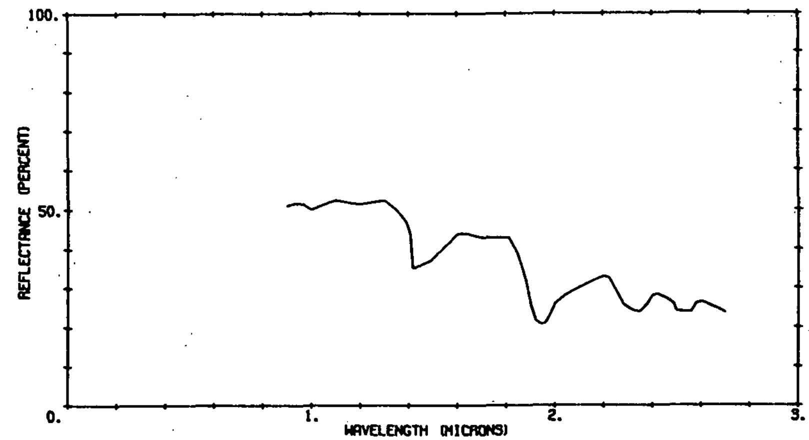
B00829 006

TUPELO GUM LEAF



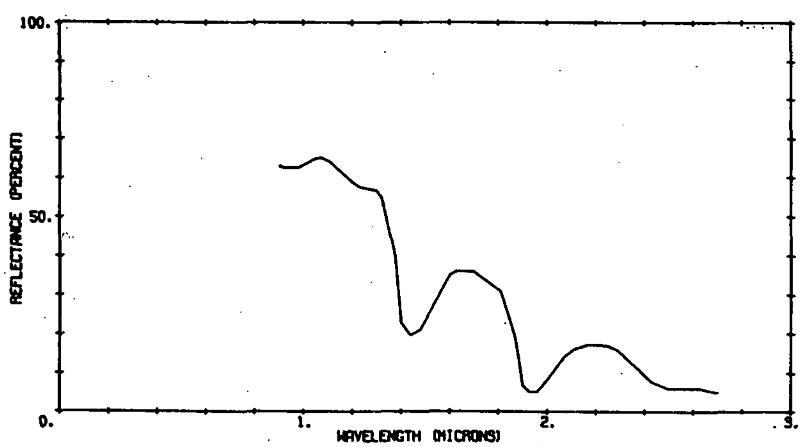
B00829 017

STRANVAESIA DAVIDISONI LEAF, TOP



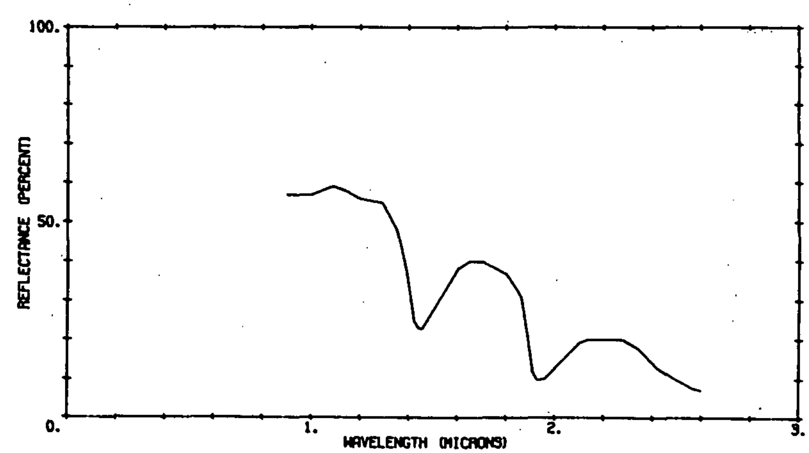
B00829 026

HAWTHORN LEAF, TOP (RED, NOT FALLEN)



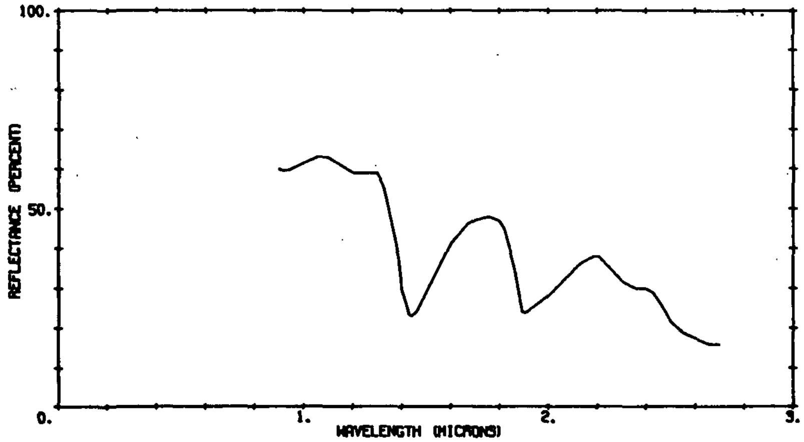
B00829 029

WILLOW, LEAF TOP, YELLOW, FALLEN



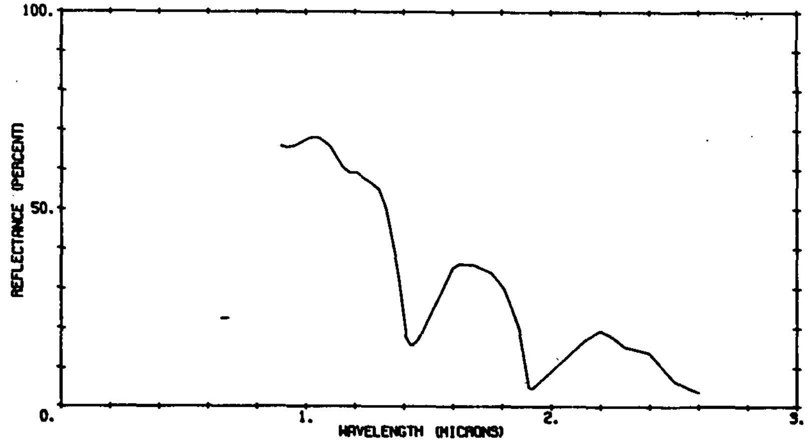
B00829 031

VIRGINIA CREEPER VINE RED LEAF (AUTUMN) TOP



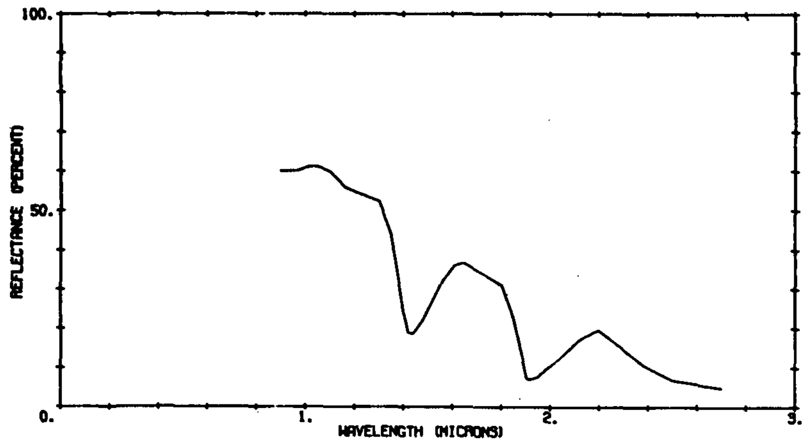
B00829 032

TRAVESIA, FOREIGN FOLIAGE



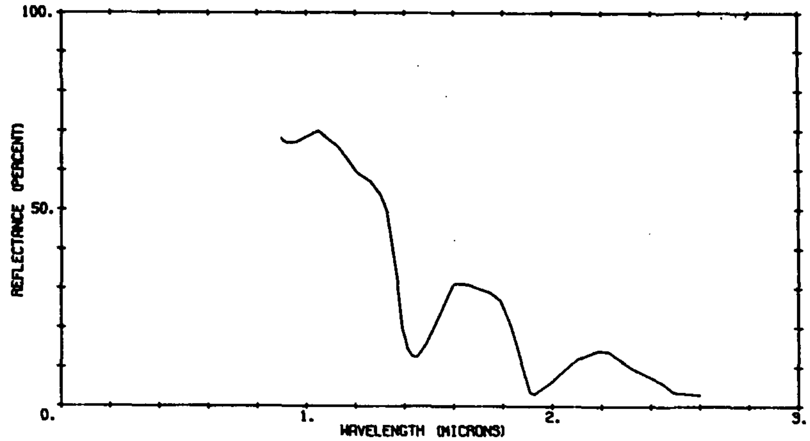
B00829 035

DWARF RATTAN FROM CHINA-TROPIC FOLIAGE



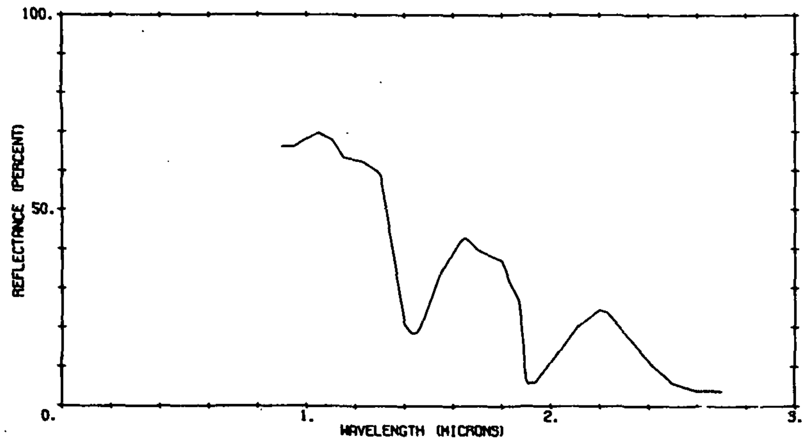
B00829 036

FLESHY LEAF, JUNGLE FOLIAGE-TROPIC FOLIAGE



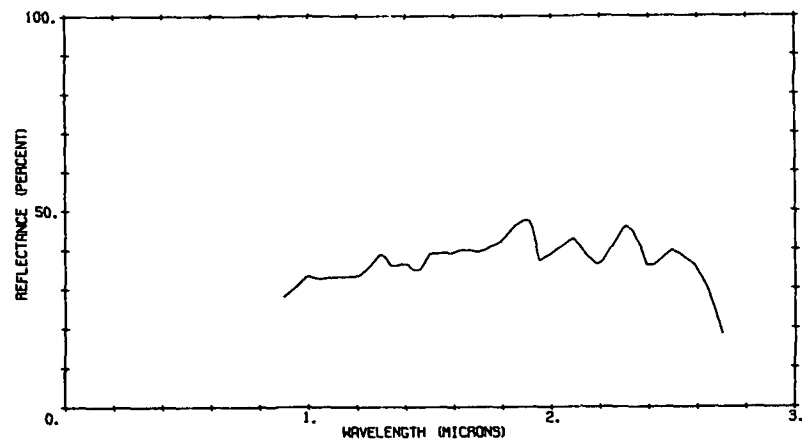
B00829 039

CALABASH TREE FROM NAT. BOTANICAL GARDENS



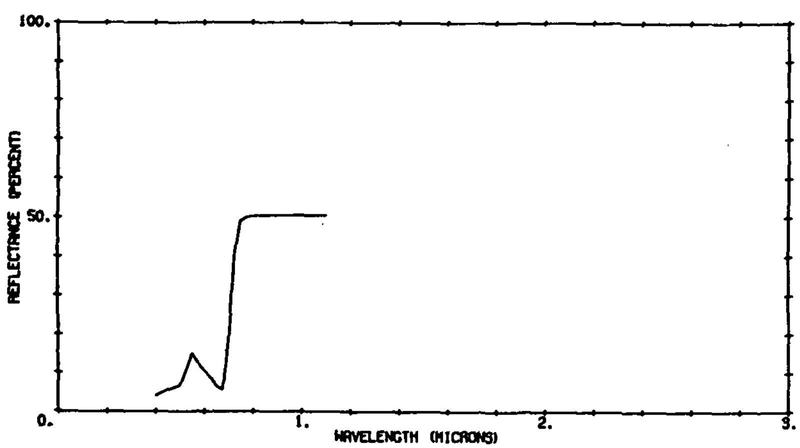
B00829 097

TUPELO GUM BARK



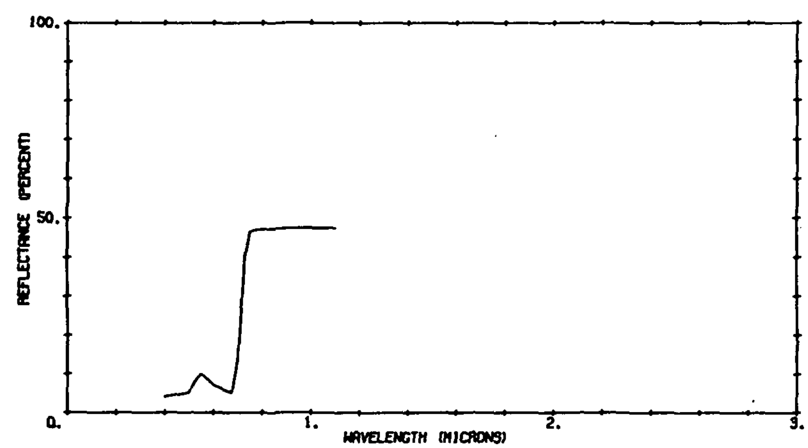
B01049 001

EUONYMUS EUROPAEA



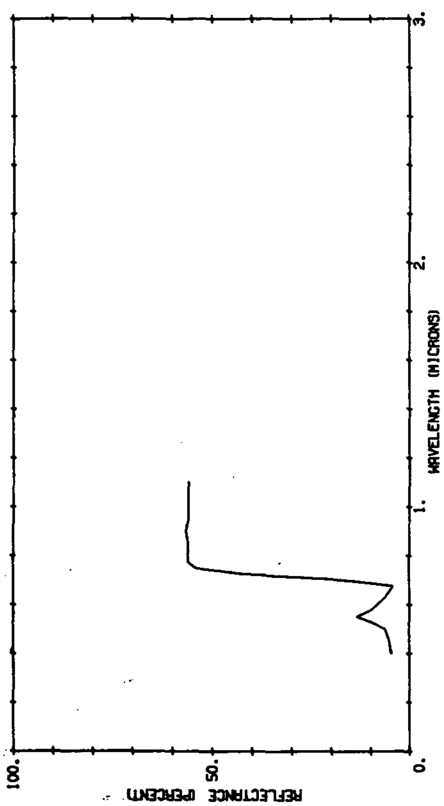
B01049 002

PHILADELPHUS SP.



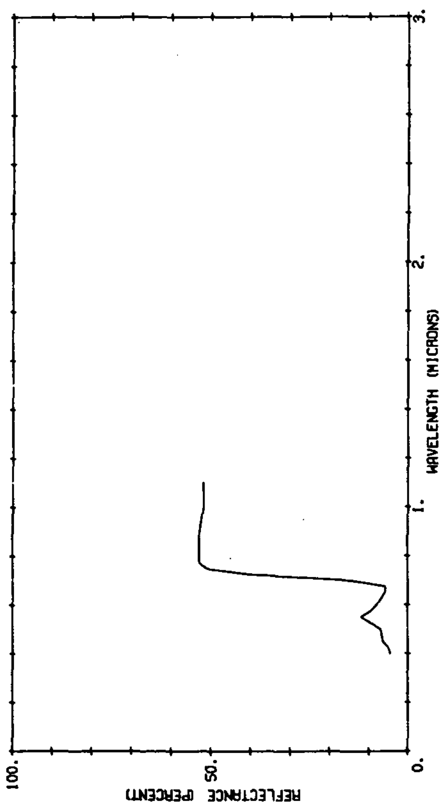
B01049 007

SALIX SCOULERIANA



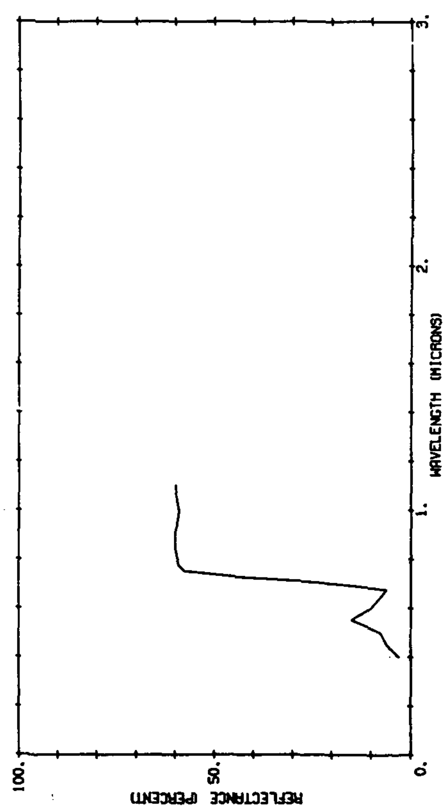
B01049 010

CEANOTHUS CORDULATUS



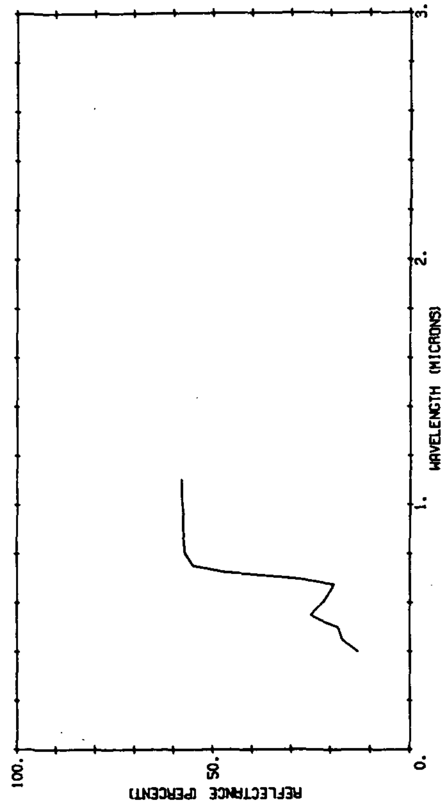
B01049 012

RHAMNUS RUBRA



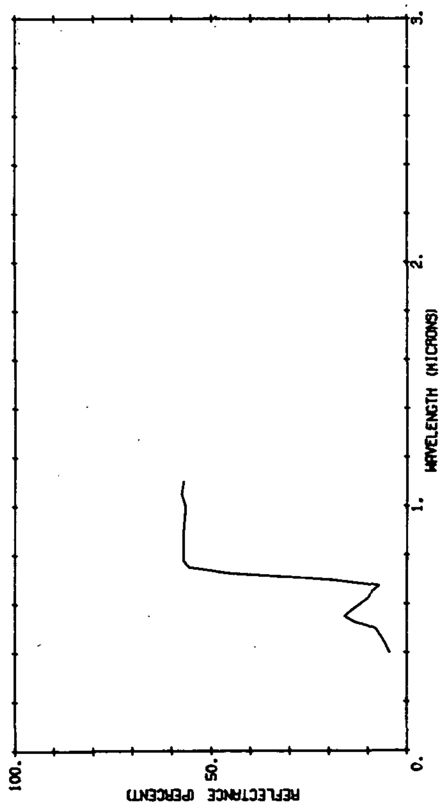
B01049 015

SALIX COMMUTATA



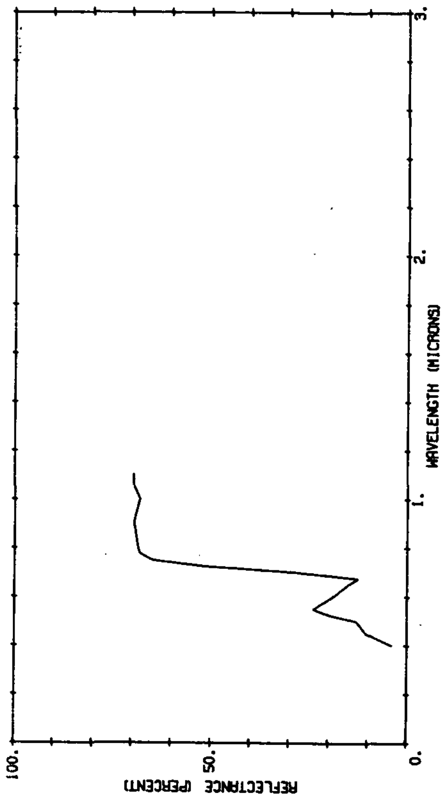
B01049 016

SALIX LEMMONII



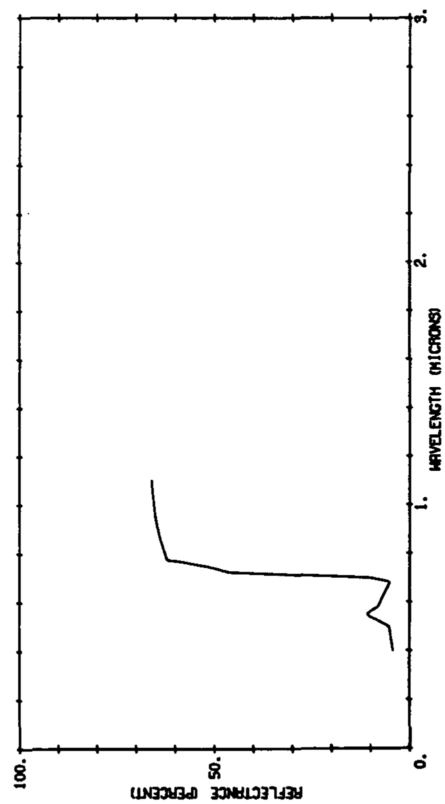
B01049 020

PRUNUS ANDERSONII



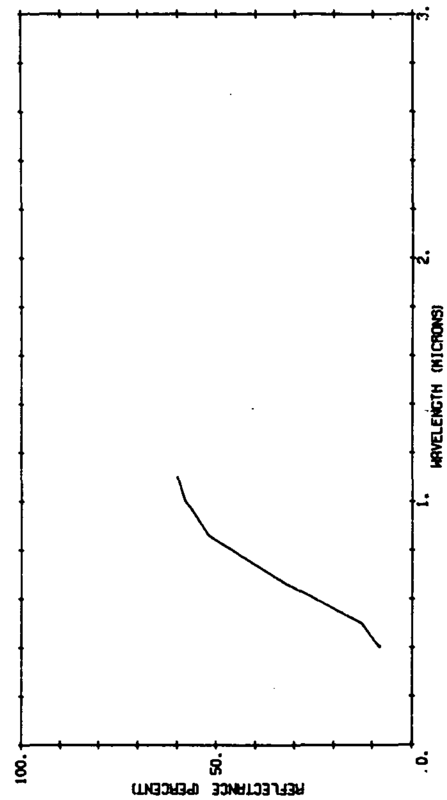
B01176 005

BRAMBLE BRIAR LEAF, GREEN



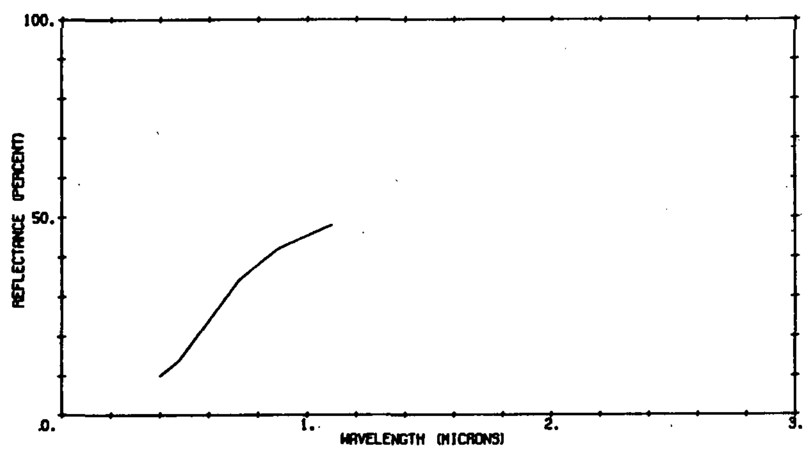
B01176 045

LEAF, DEAD



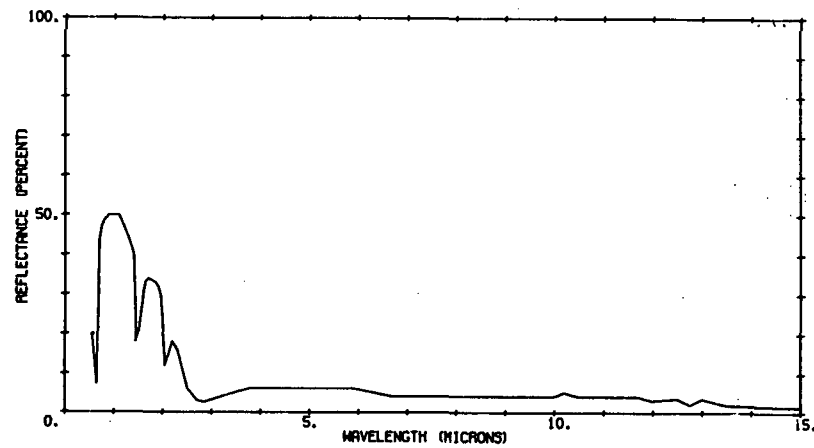
B01176 046

STRAW, DEAD



B01818 009

WILLOW LEAF, YOUNG, TOP (SALIX FRAGILIS) DRY

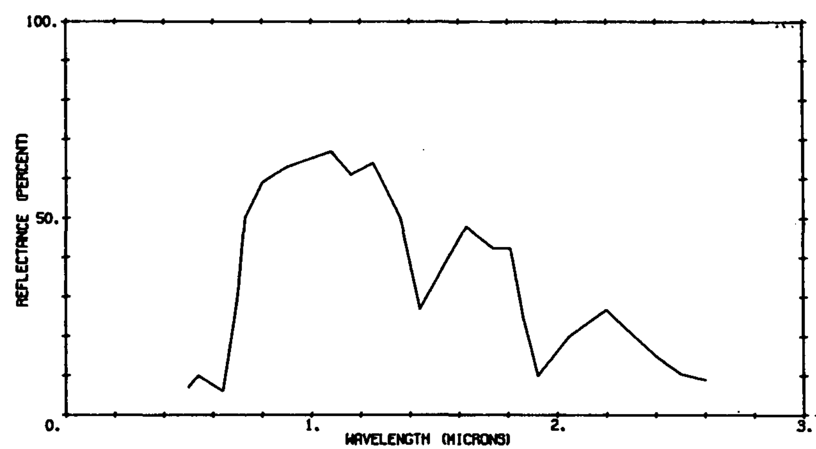


B02418 366

VIS. UNKNOWN SPECIES, GREEN

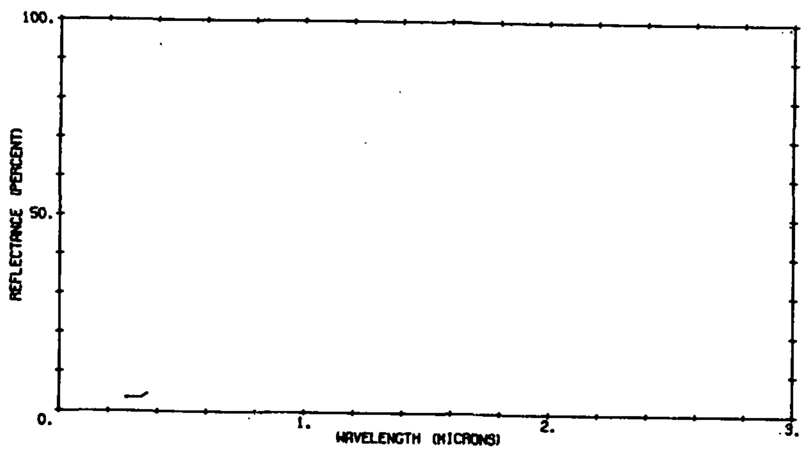
B02418 367

I.R. UNKNOWN SPECIES, GREEN



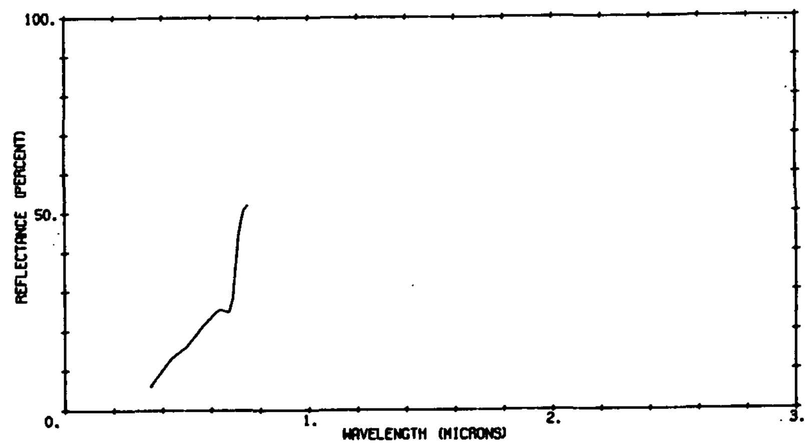
B02418 377

U.V. UNKNOWN SPECIES



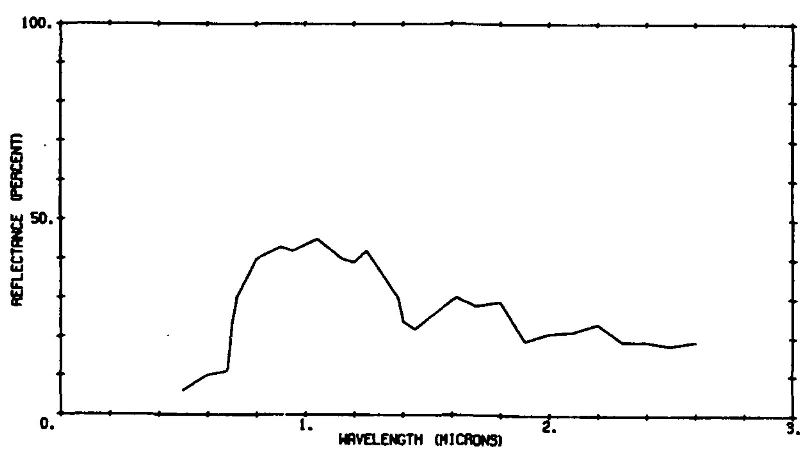
B02418 378

VIS. UNKNOWN SPECIES



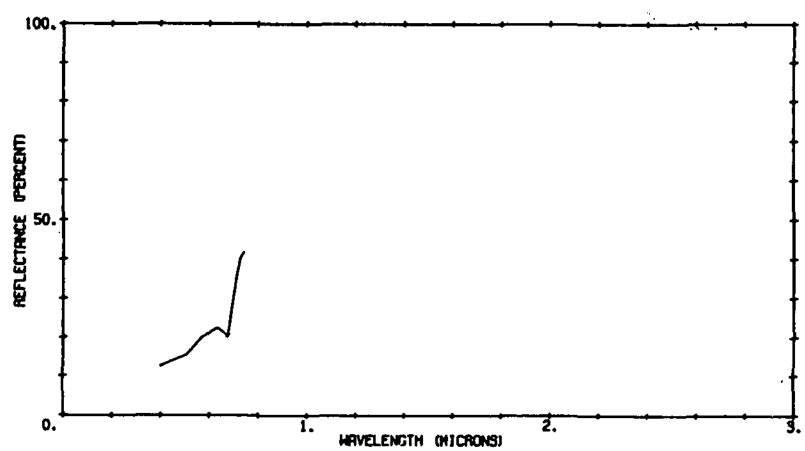
B02418 379

I.R. UNKNOWN SPECIES



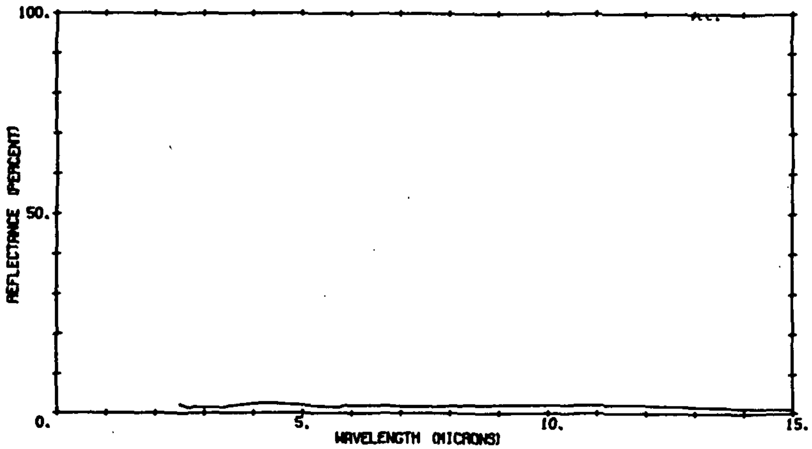
B04696 007

APPLE BARK (NORTHERN SPY), UNHEALTHY TREE.



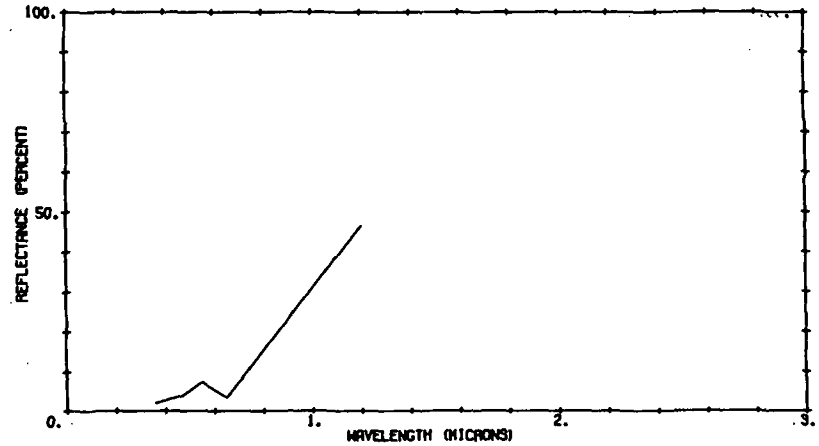
B04696 042

APPLE LEAF (NORTHERN SPY), HEALTHY TREE, UPPER LEAF SURFACE.



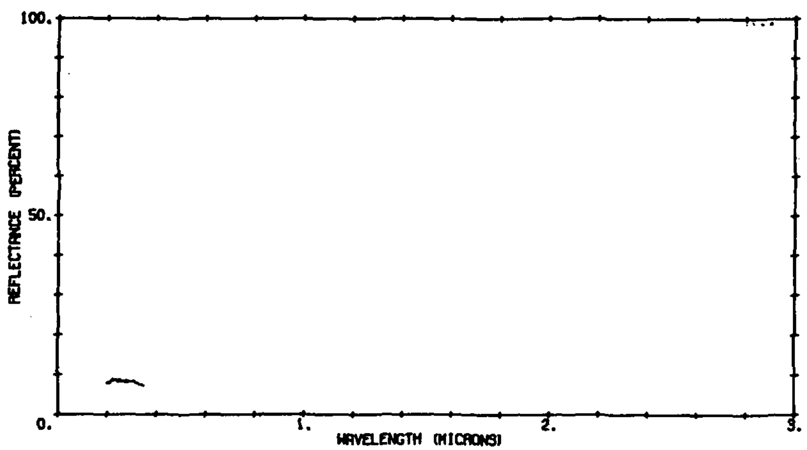
B13946 016

LIGHT GREEN AND DARK GREEN LEAVES, WET.



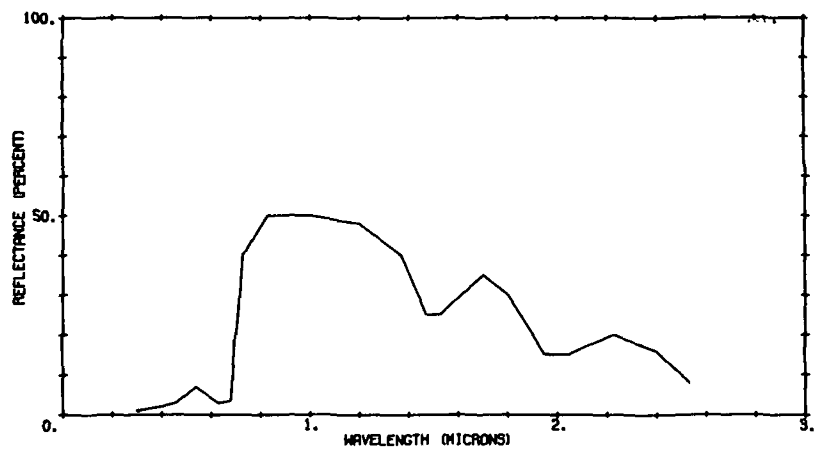
B13946 024

PALM LEAVES.



B13946 032

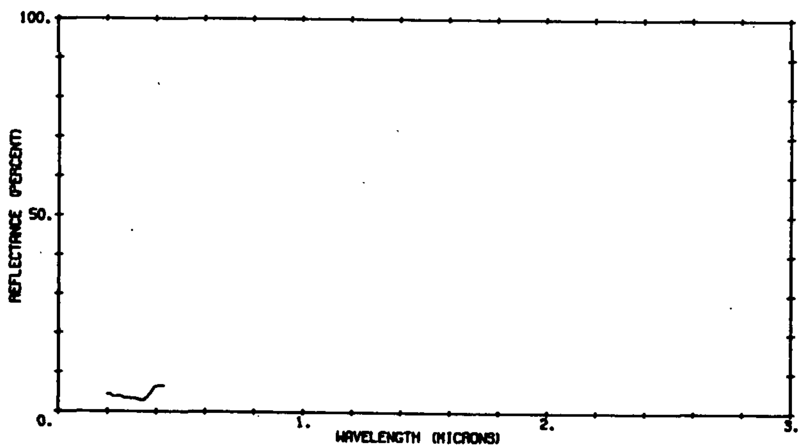
PLANT LEAVES.



BG 9

B14004 027

BOSTON FERN LEAF

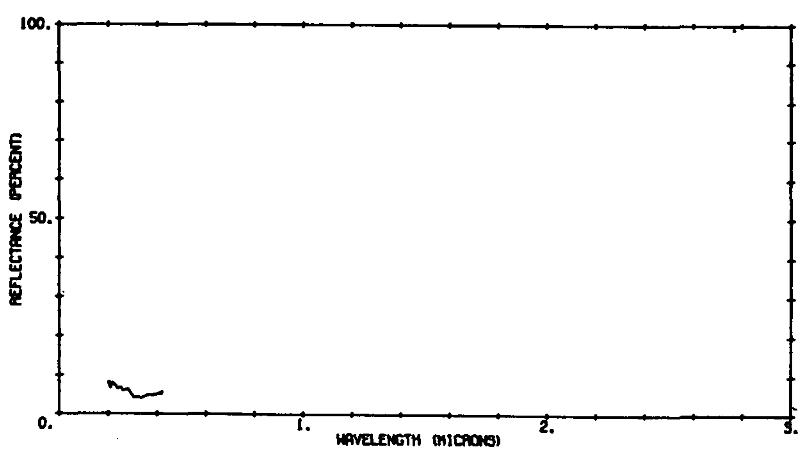


B14004 028

BOSTON FERN LEAF

B14004 046

LANTANNA LEAF, 2 HRS. AFTER PICKING

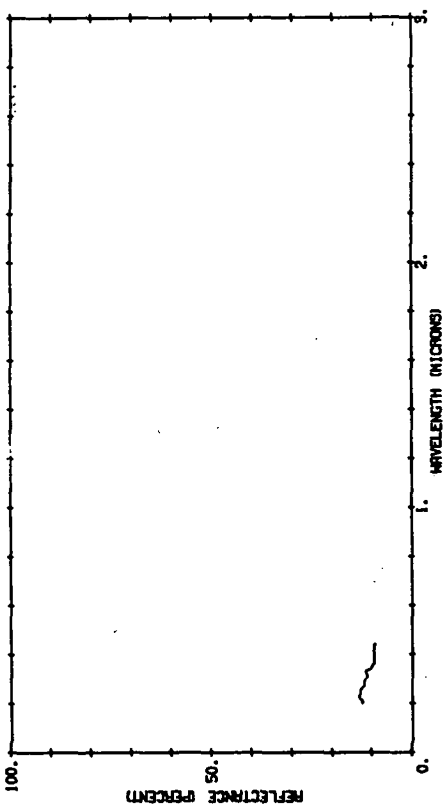


B14004 049

BLEEDING HEART LEAF, 2 HRS. AFTER PICKING

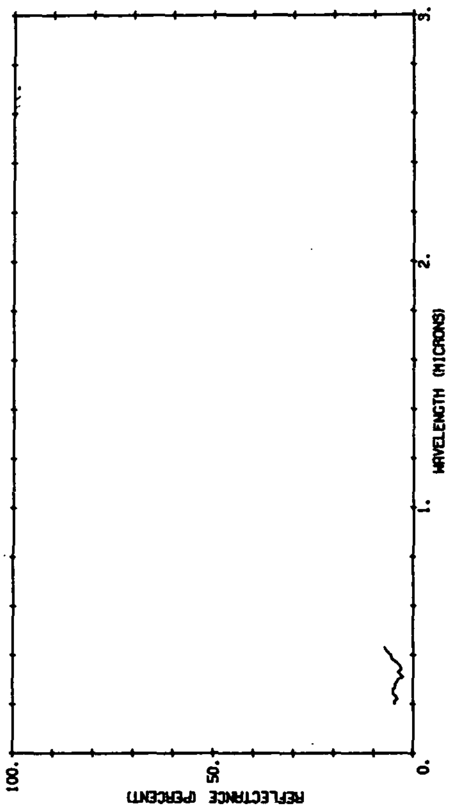
B14004 050

BLEEDING HEART LEAF, 2 DAYS AFTER PICKING



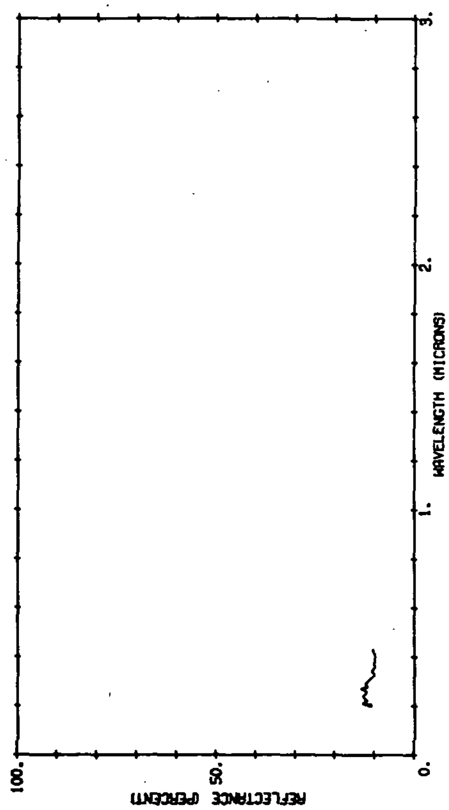
B14004 052

LANTANNA LEAF, 2 DAYS AFTER PICKING



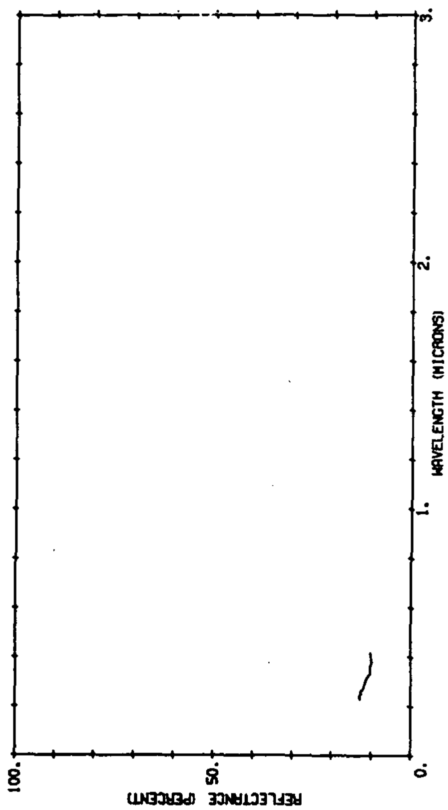
B14004 063

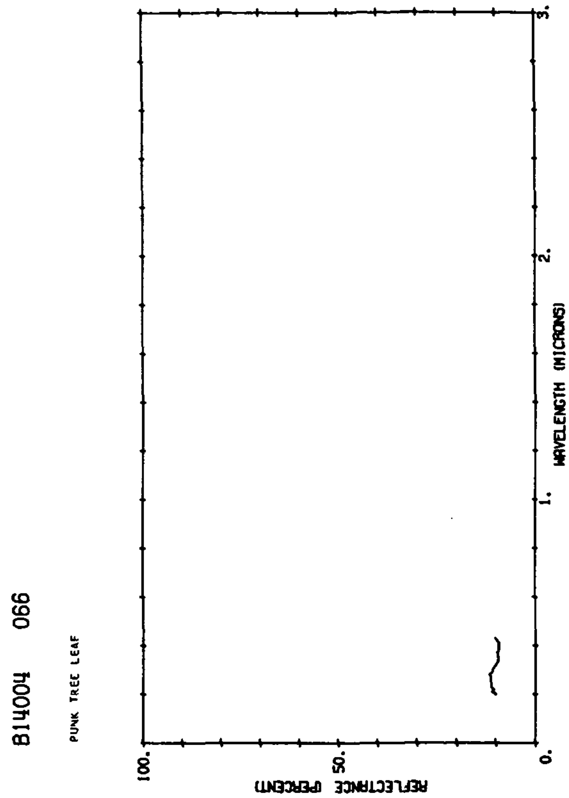
PUNK TREE LEAF

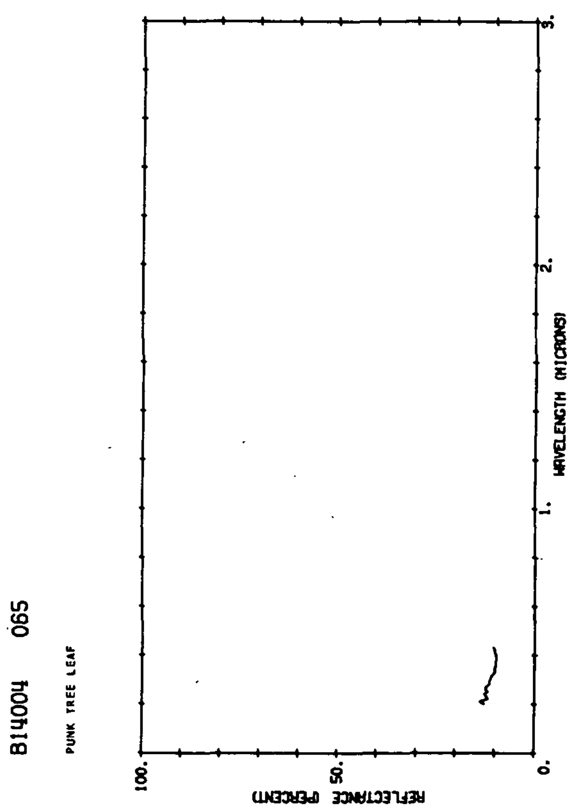


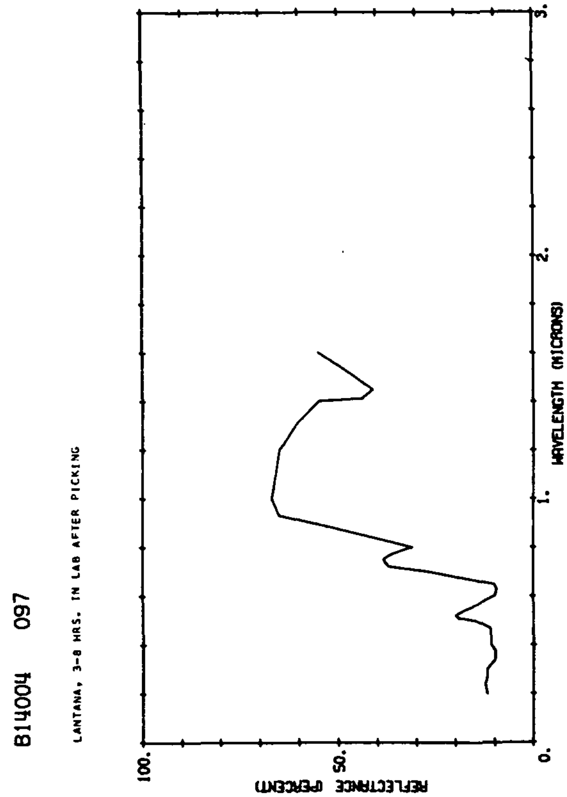
B14004 064

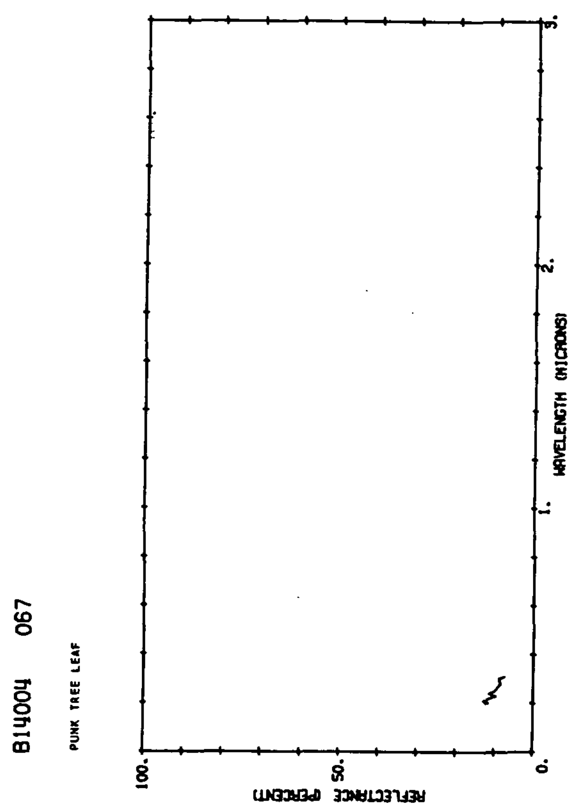
PUNK TREE LEAF




B14004 066
PUNK TREE LEAF
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

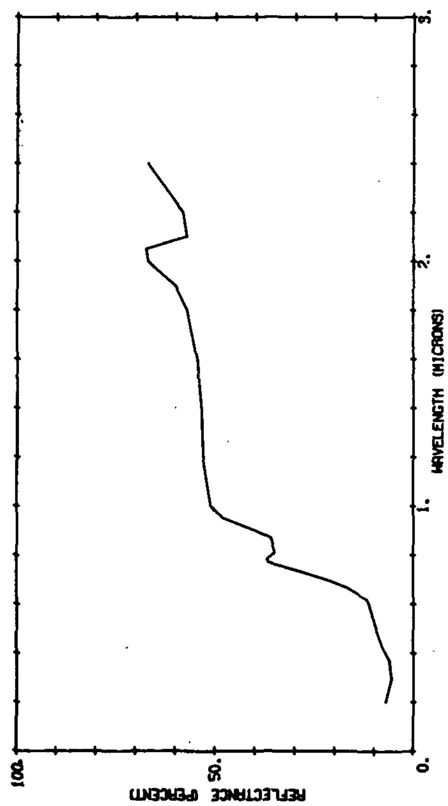

B14004 065
PUNK TREE LEAF
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B14004 097
LANTANA, 3-8 HRS. IN LAB AFTER PICKING
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B14004 067
PUNK TREE LEAF
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

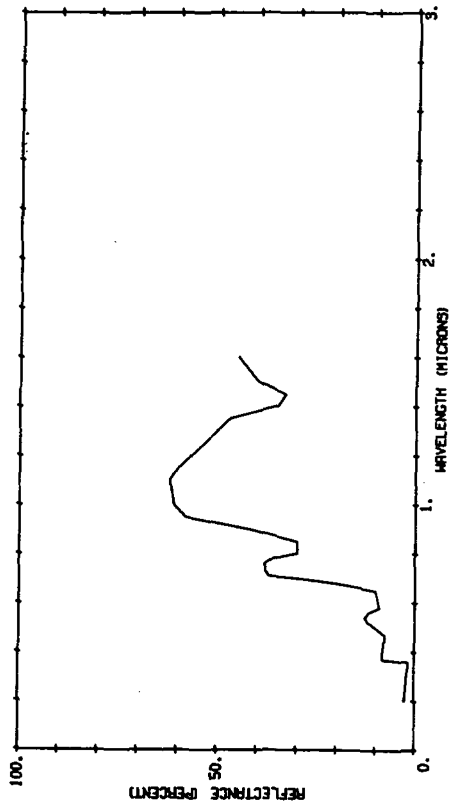
B14004 098

LANTANA, 3 DAYS IN WEATHER AFTER PICKING



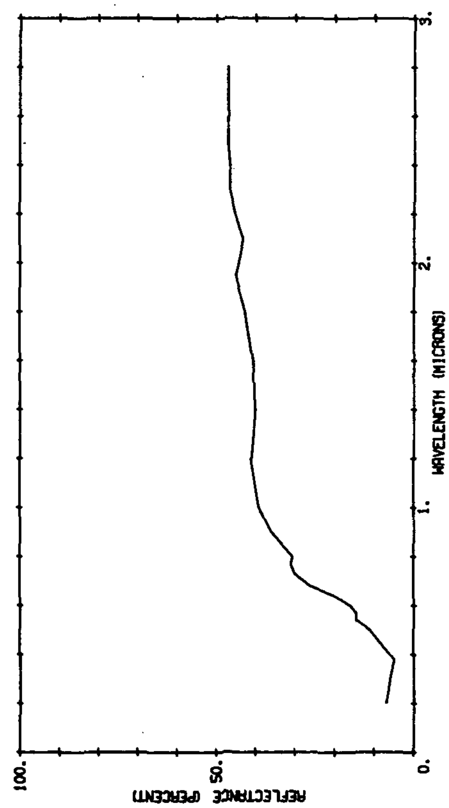
B14004 109

BOSTON FERN, 3-8 HRS. IN LAB AFTER PICKING



B14004 110

BOSTON FERN, 3 DAYS IN WEATHER AFTER PICKING



BGB

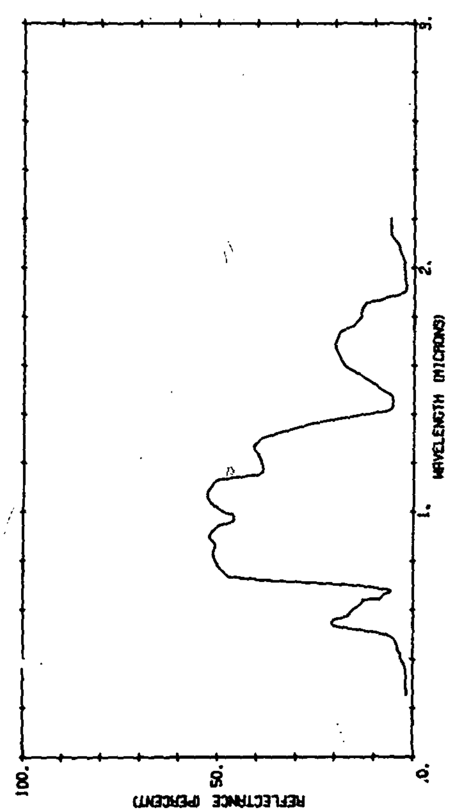
VEGETATION

Moss-Liverwort

283

B03333 001

SPHAGNUM MOSS.



BGC

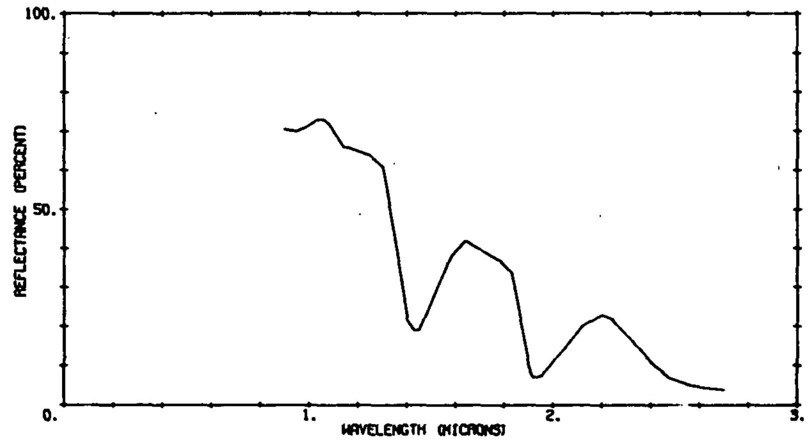
VEGETATION

Vascular

285

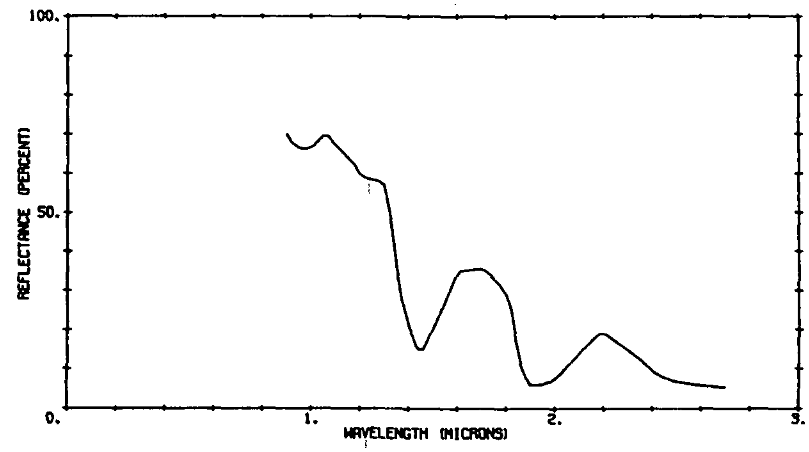
B00829 037

ARABIAN COFFEE PLANT LEAF TOP FROM NAT. BOTANICAL GARDENS



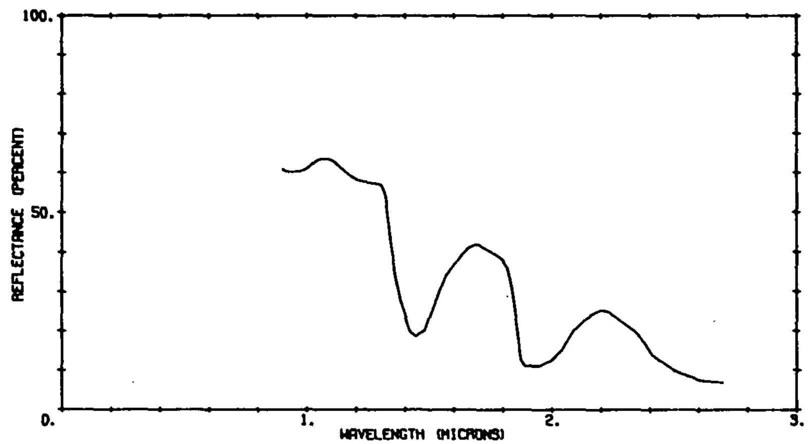
B00829 101

RUGEL-S PLANTAIN, LEAF, TOP



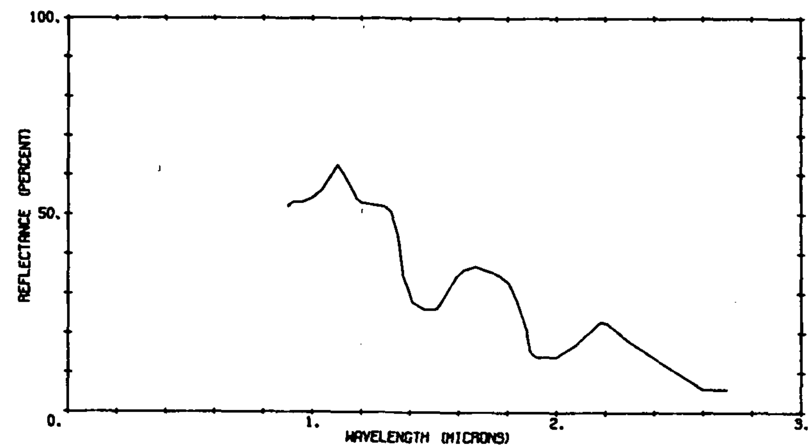
B00829 102

BRACKEN FERN, LEAF, TOP, MATURE



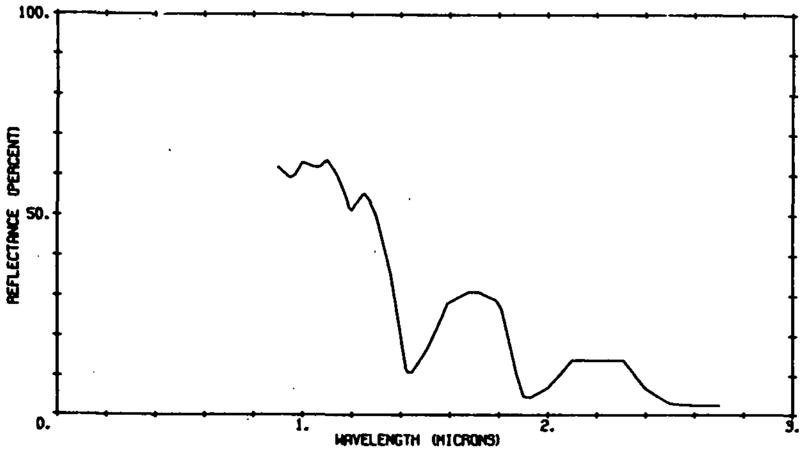
B00829 104

RAGWEED LEAVES



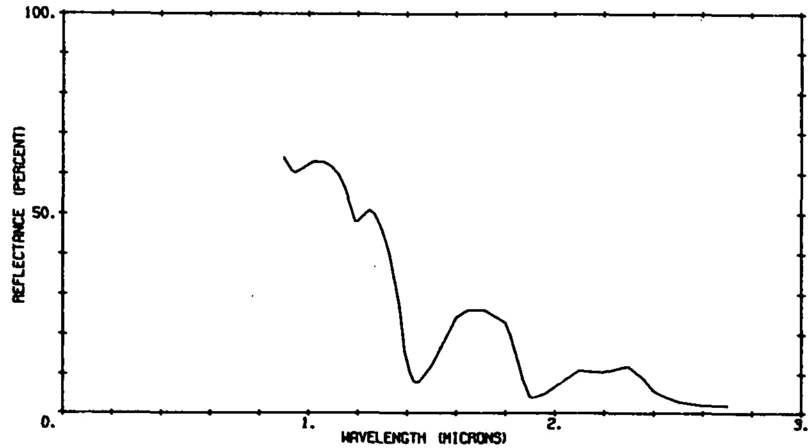
B00829 105

MUSTARD, LEAF OF CULTIVATED CROP PLANT



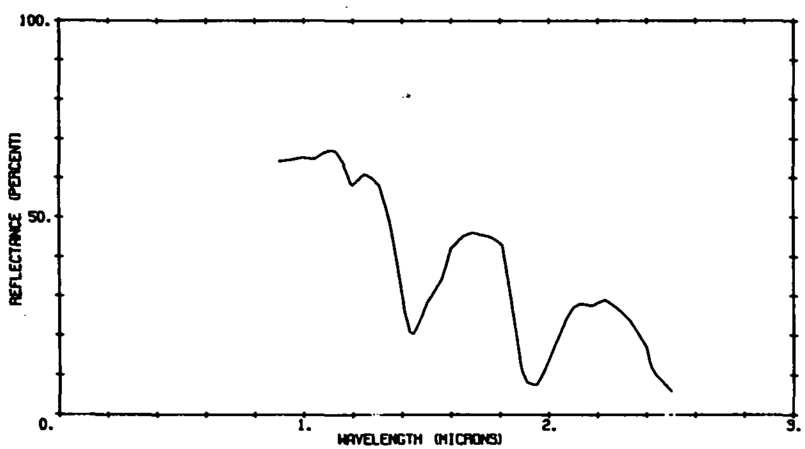
B00829 106

CABBAGE, LEAF OF GARDEN PLANT



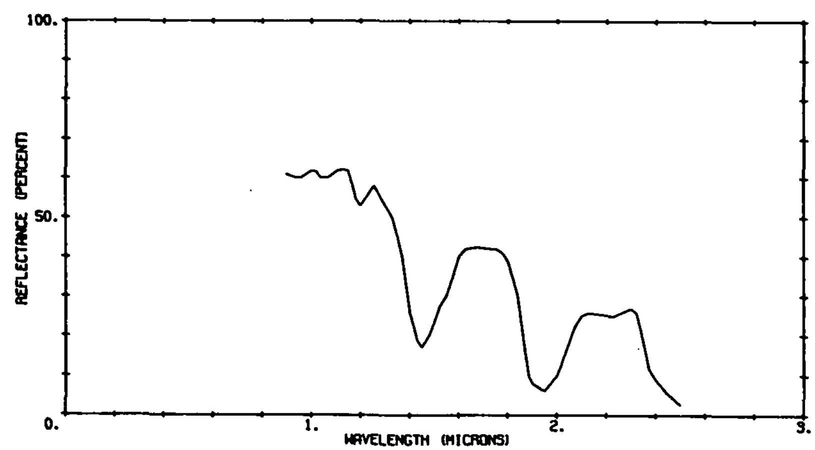
B00829 108

SWEET POTATO VINE LEAF



B00829 109

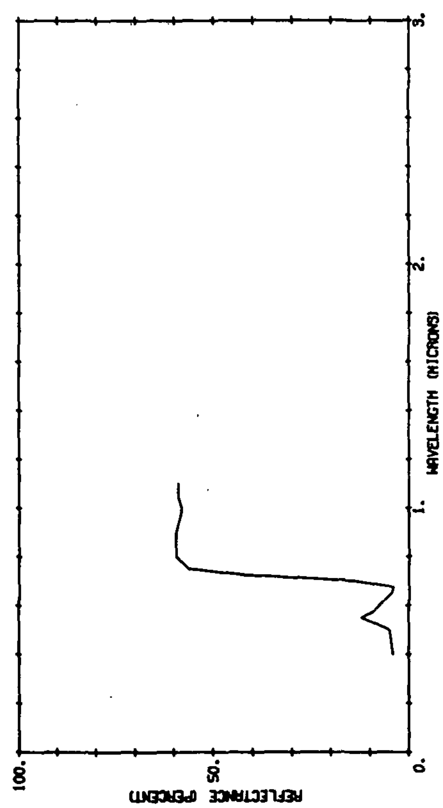
STRING BEAN, BUSH VARIETY, LEAF



BGC 3

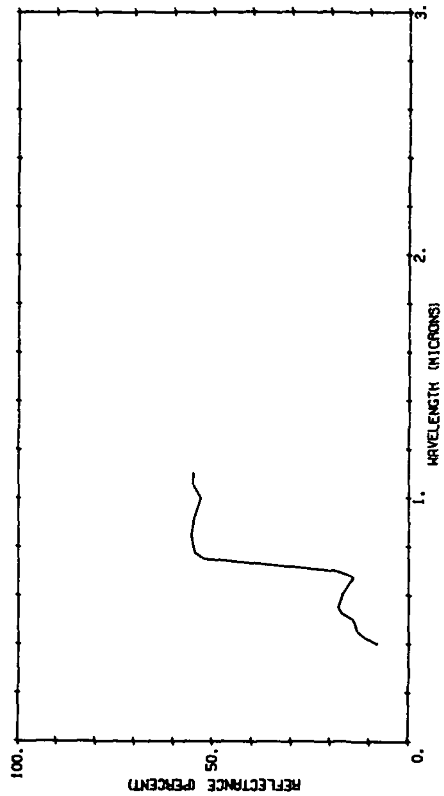
B01049 006

LUPINUS SUPERBUS VAR. ELONGATUS



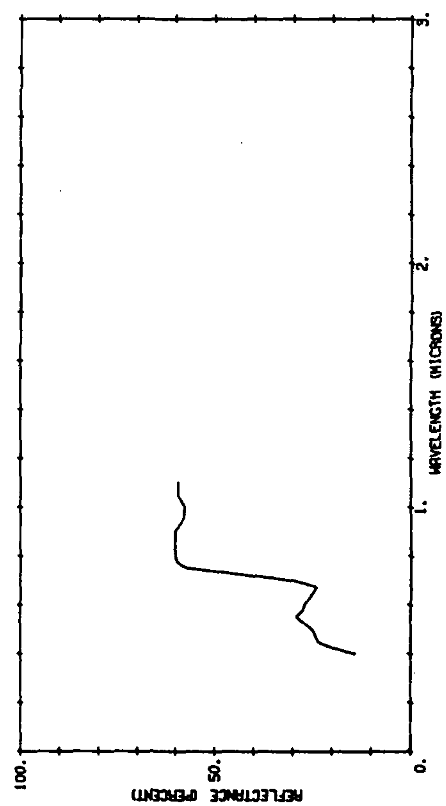
B01049 017

ATRIPLEX CANESCENS



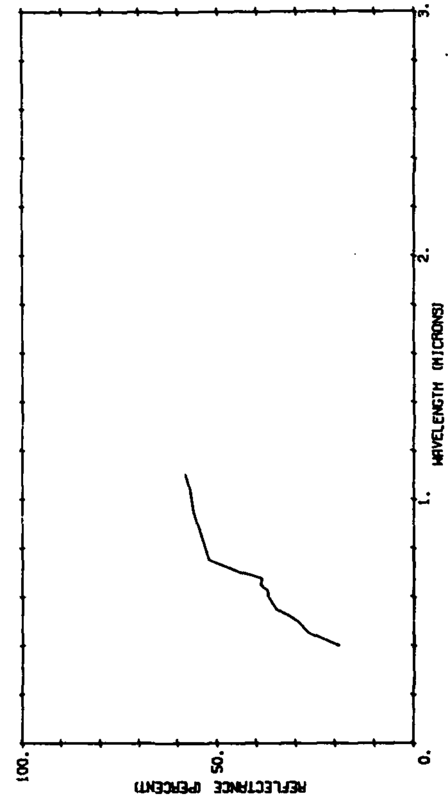
B01049 018

ATRIPLEX LENTIFORMIS



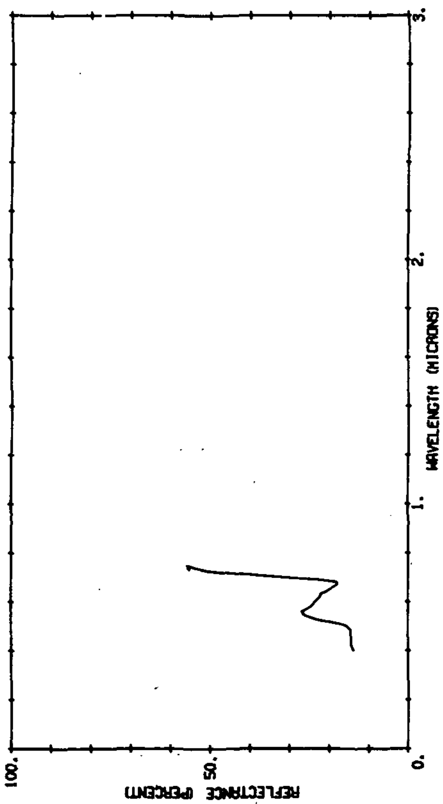
B01049 019

EUROTIA LANATA



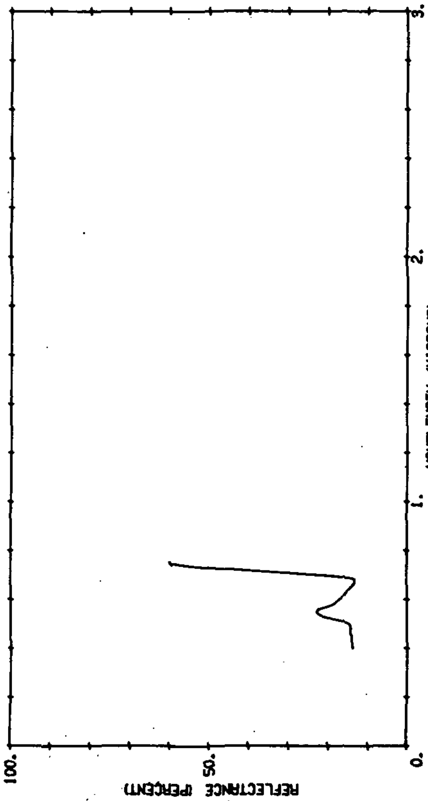
B01352 001

RYE LEAVES, DISEASED.



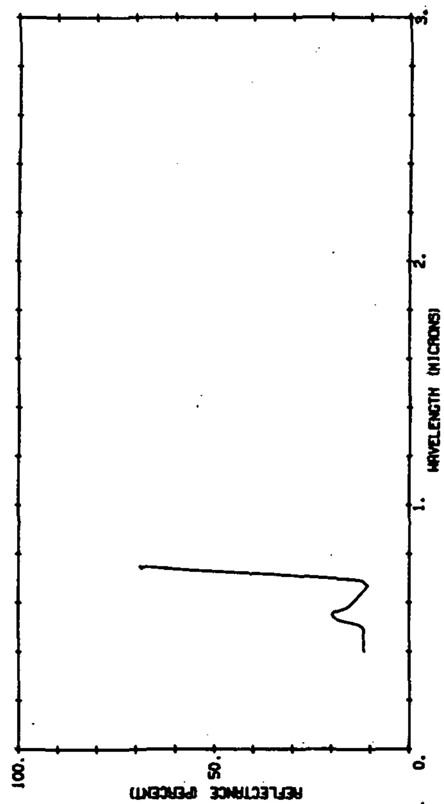
B01352 002

RYE LEAVES, NON-DISEASED.



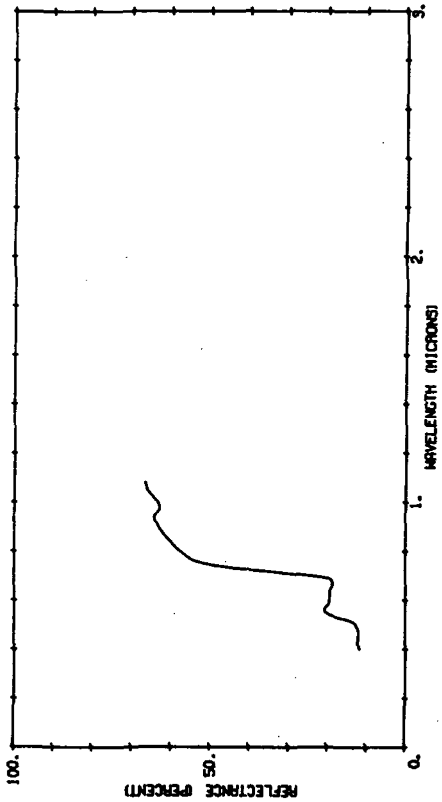
B01352 003

RYE LEAVES (UNPOTTED PLANT).



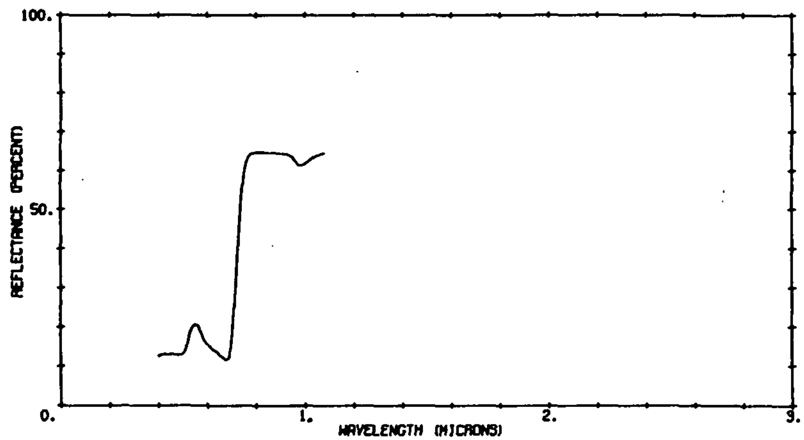
B01352 004

LEAVES OF SUWON, SPRAYED AND INOCULATED.



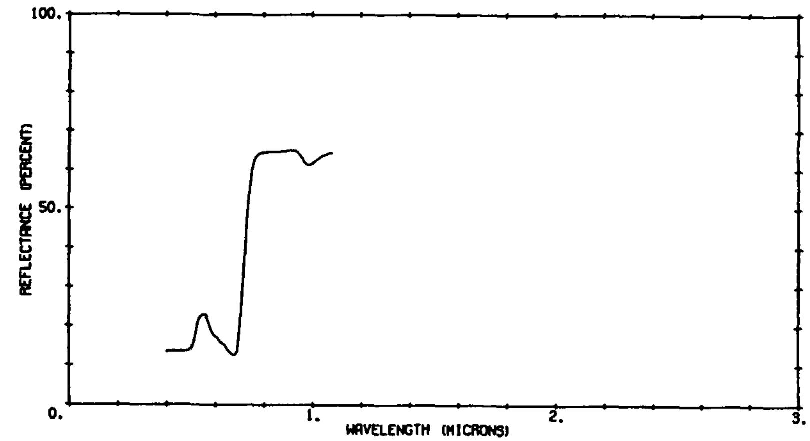
B01352 005

LEAVES OF SUWON, SPRAYED.



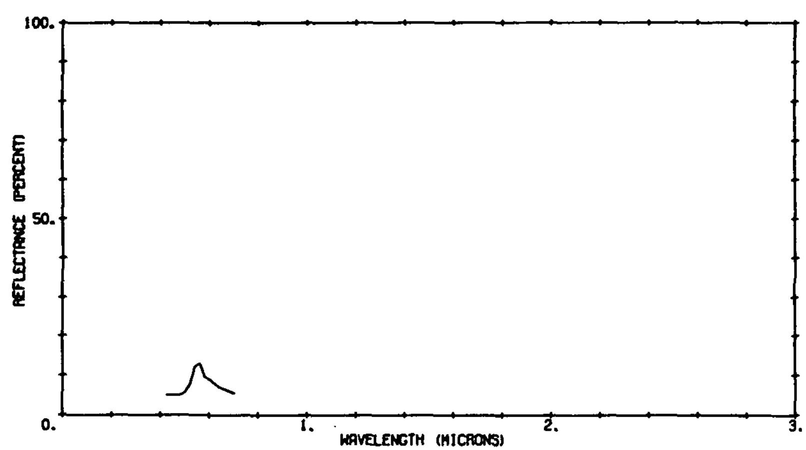
B01352 006

LEAVES OF LEE, NATURAL.



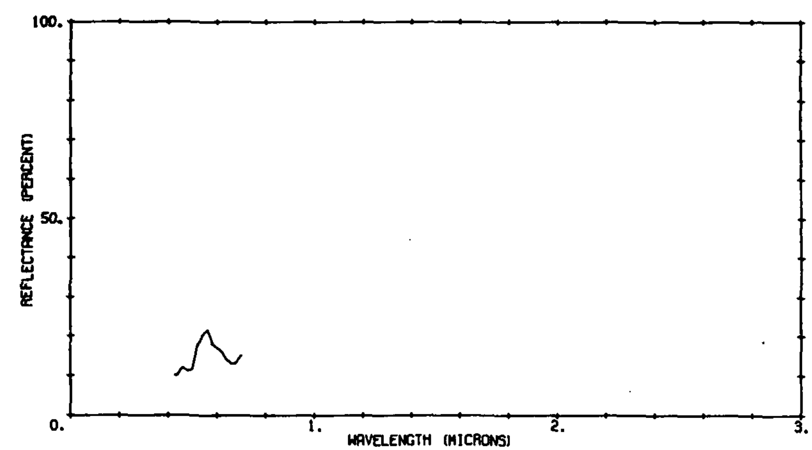
B01761 029

MILKWEED, ASCLEPIAS SYRIACA, UPPER LEAF SURFACE.



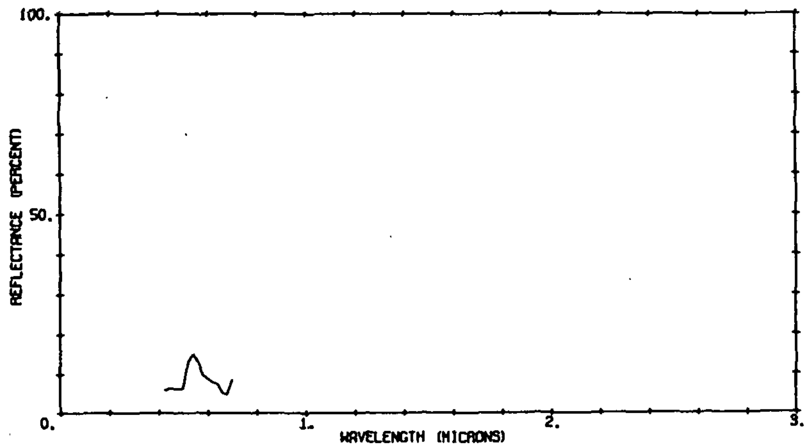
B01761 030

MILKWEED, ASCLEPIAS SYRIACA, LOWER LEAF SURFACE.



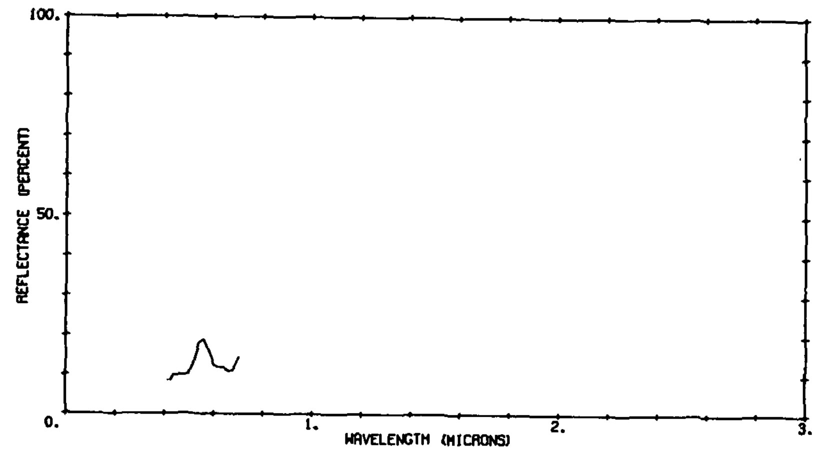
B01761 031

COCKLEBUR, XANTHIUM ITALICUM, UPPER LEAF SURFACE.



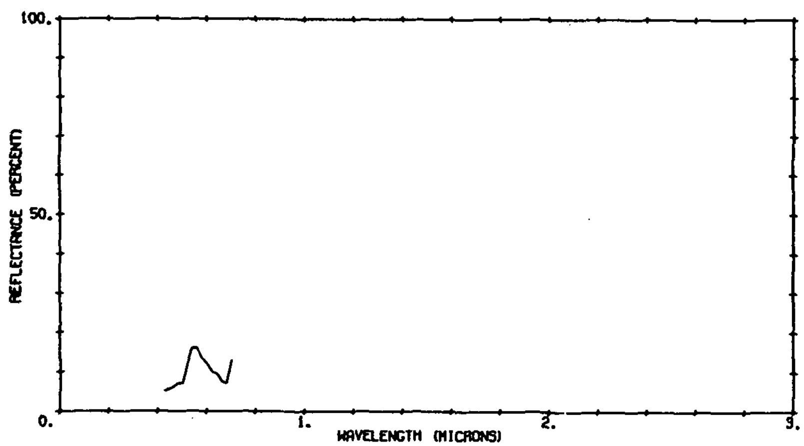
B01761 032

COCKLEBUR, XANTHIUM ITALICUM, LOWER LEAF SURFACE.



B01761 033

BURDOCK, ARCTIUM MINUS, UPPER LEAF SURFACE.

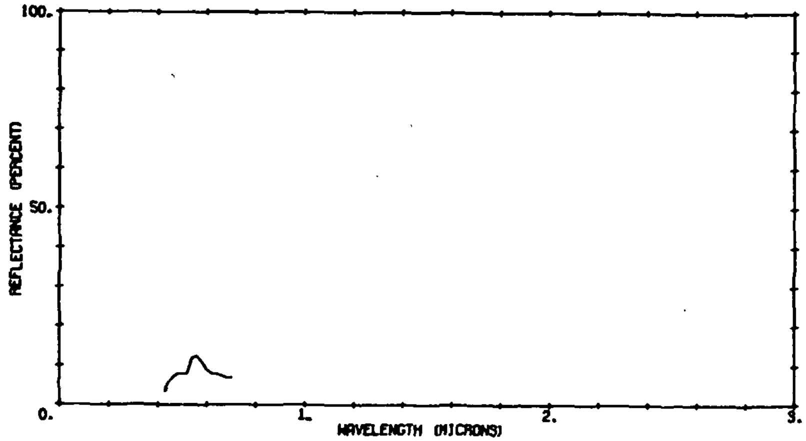


B01761 034

BURDOCK, ARCTIUM MINUS, LOWER LEAF SURFACE.

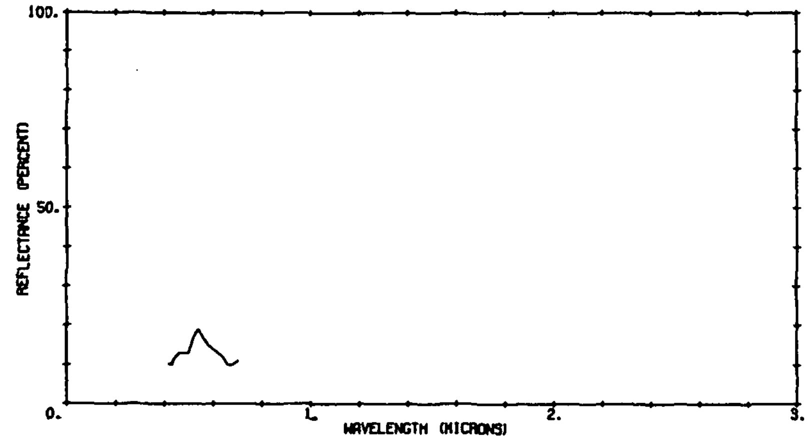
B01761 052

INDIAN MALLOW, ABUTILON THEOPHRASTI, UPPER LEAF SURFACE.



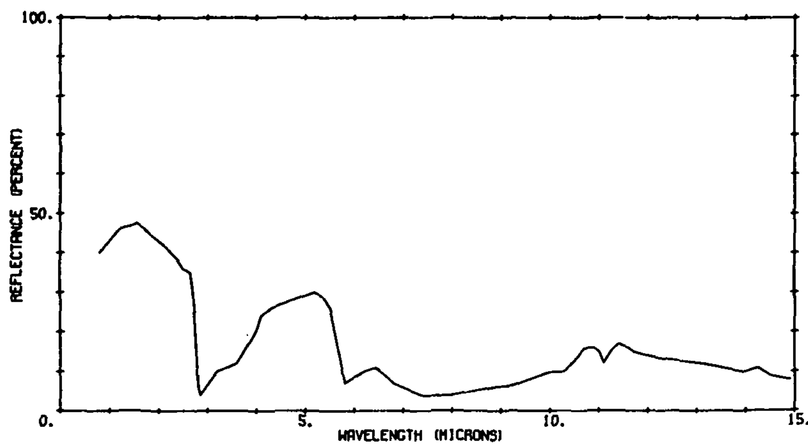
B01761 053

INDIAN MALLOW, ABUTILON THEOPHRASTI, LOWER LEAF SURFACE.



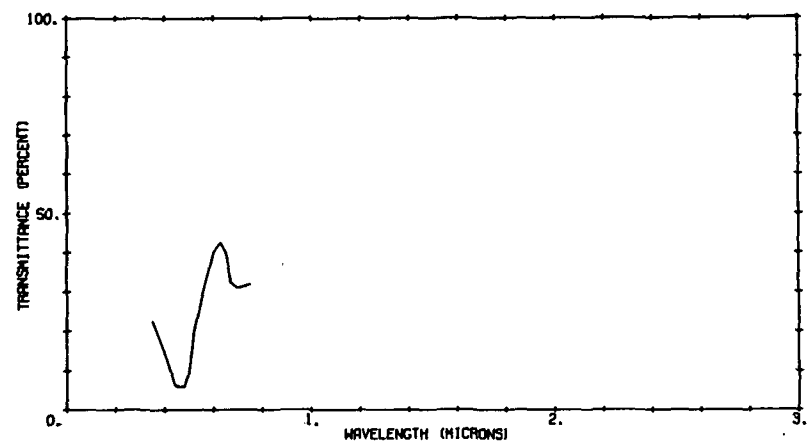
B01818 015

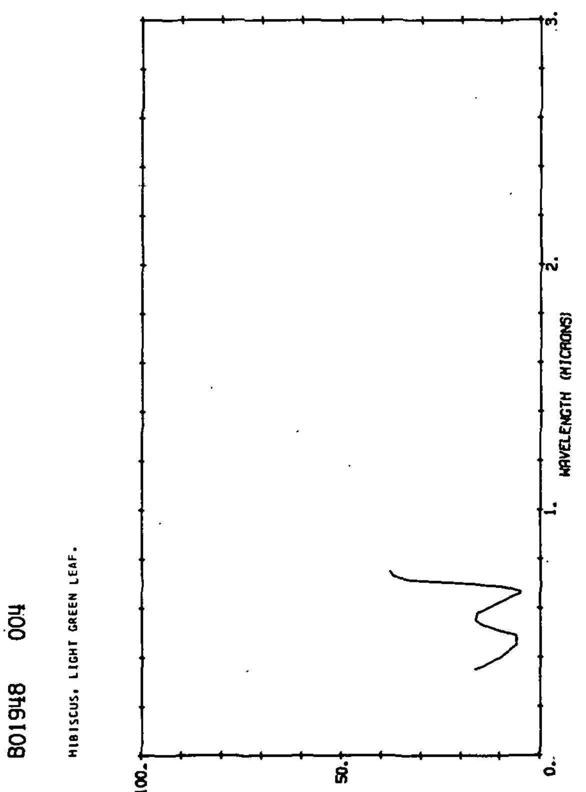
FESCUE, MEADOW, DRY GRASS

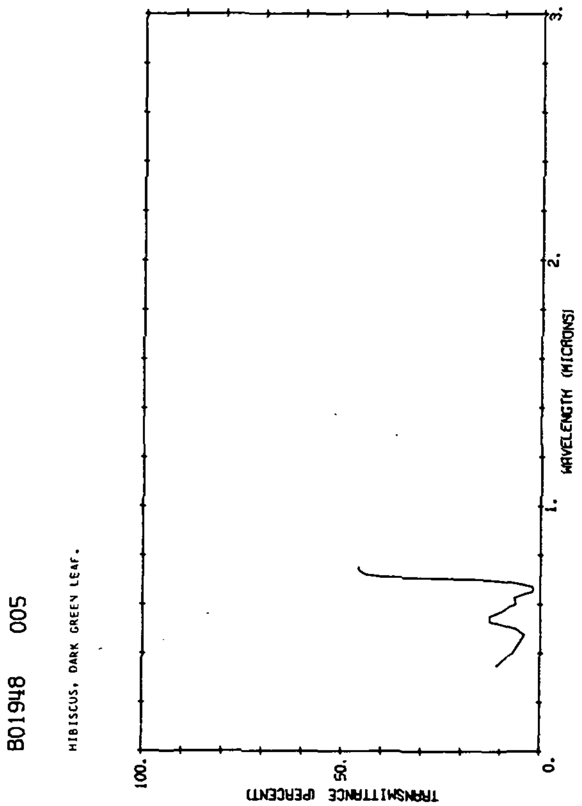


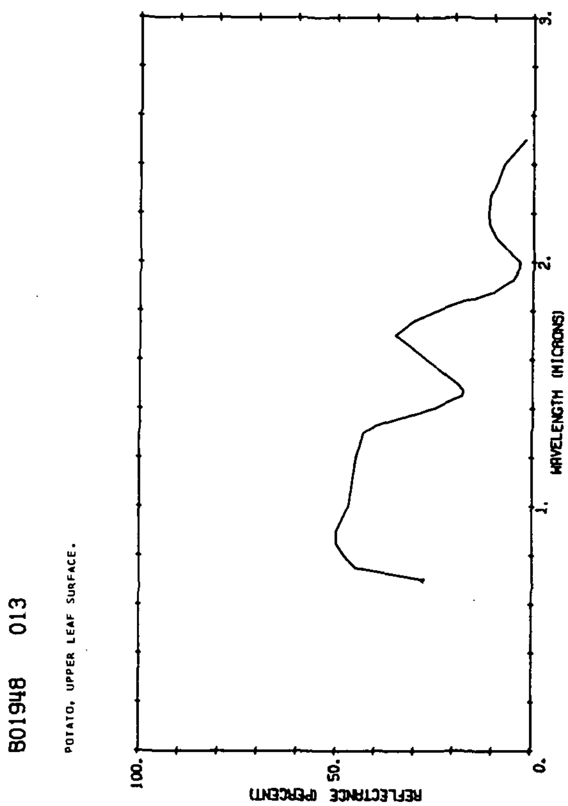
B01948 003

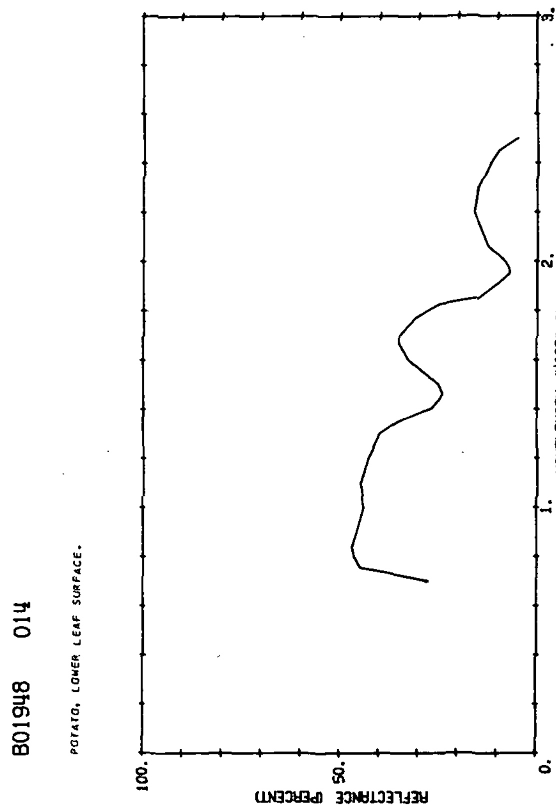
HIBISCUS, YELLOW LEAF.




B01948 004
HIBISCUS, LIGHT GREEN LEAF.
TRANSMITTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

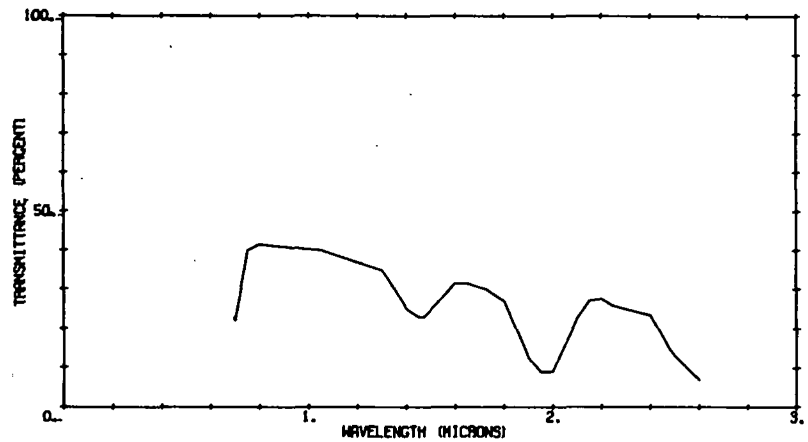

B01948 005
HIBISCUS, DARK GREEN LEAF.
TRANSMITTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B01948 013
POTATO, UPPER LEAF SURFACE.
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B01948 014
POTATO, LOWER LEAF SURFACE.
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

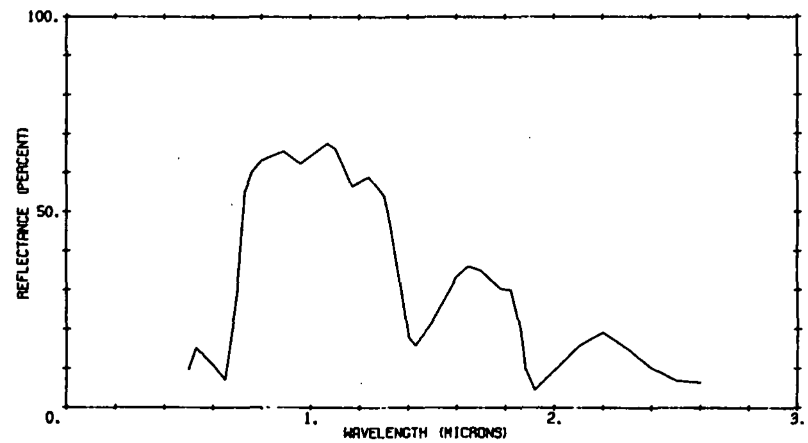
B01948 015

POTATO, LEAF.



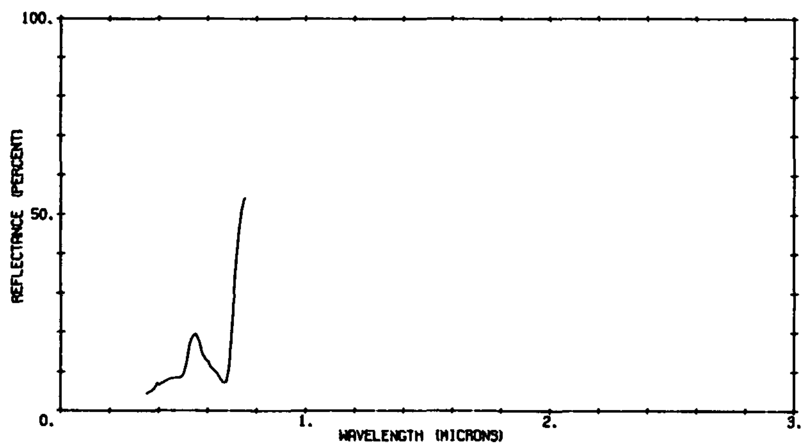
B02418 333

I.R. BIRDSFOOT TREFOIL



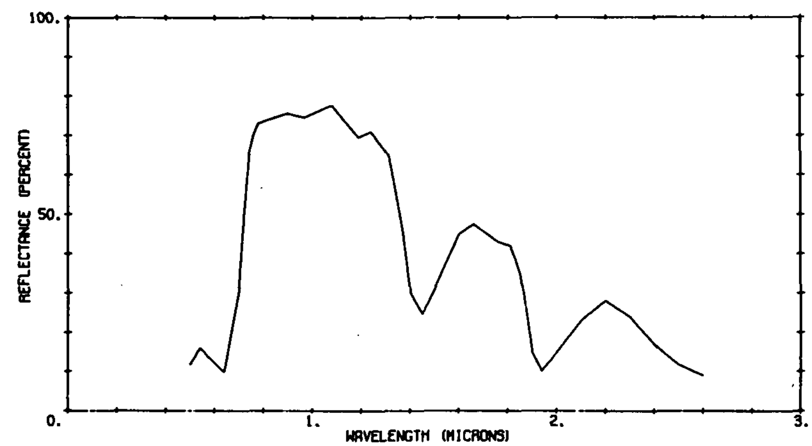
B02418 334

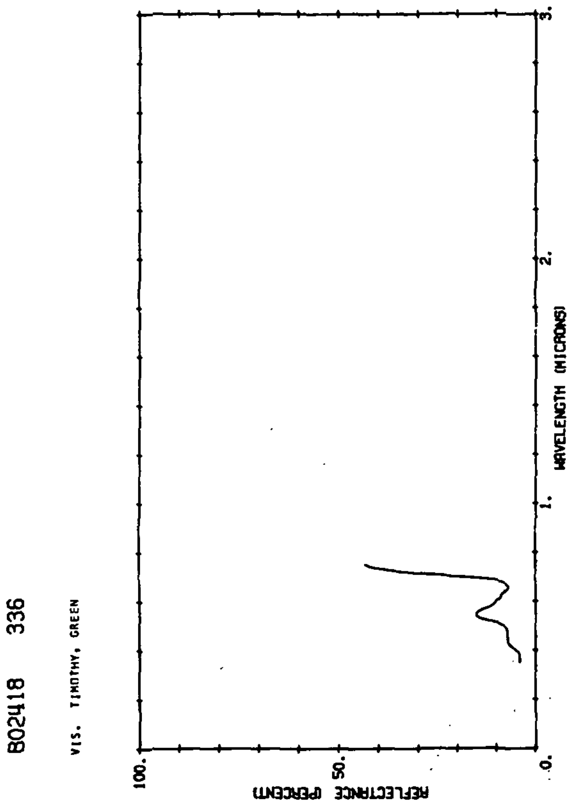
VIS. BROMEGRASS, GREEN

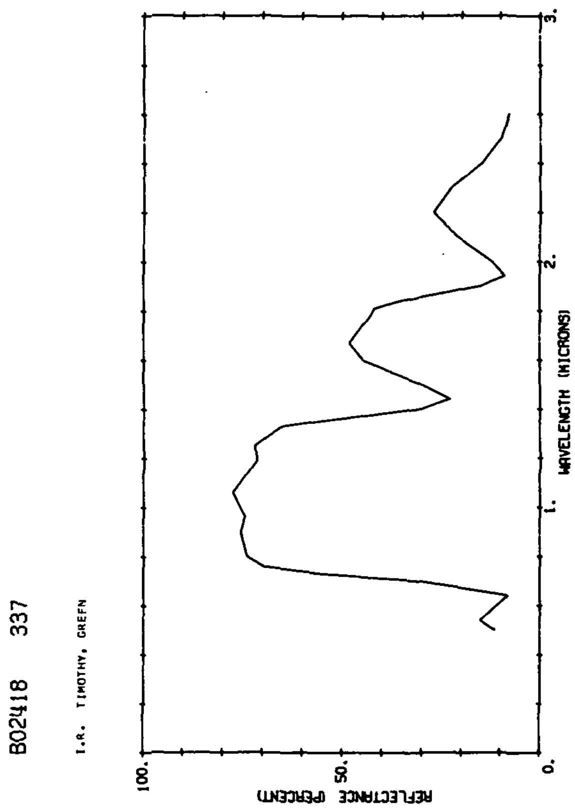


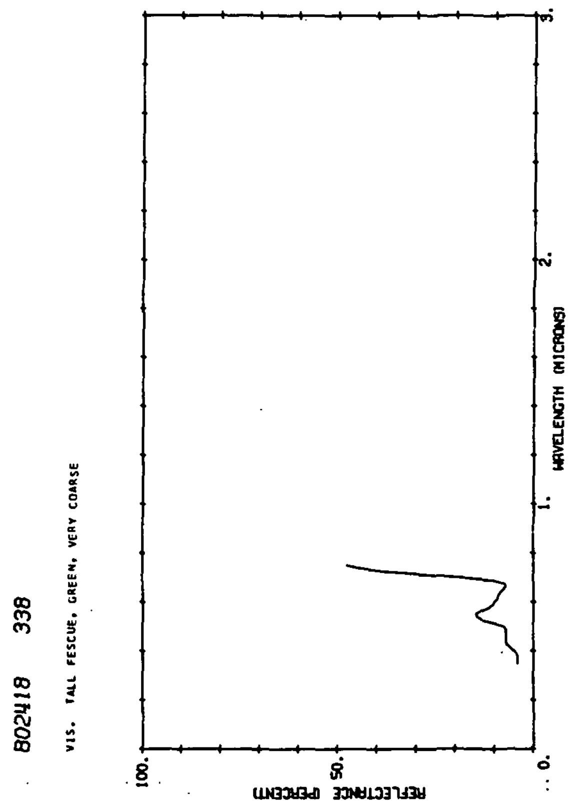
B02418 335

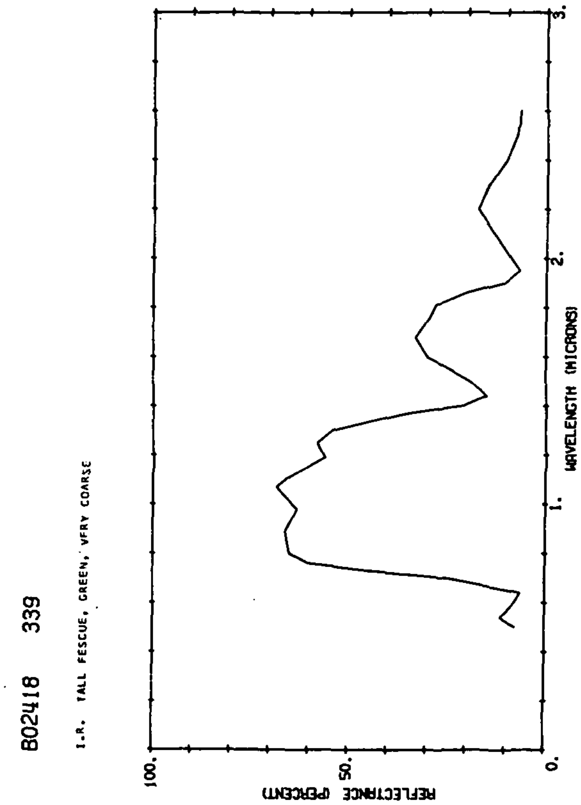
I.R. BROMEGRASS, GREEN




B02418 336
VIS. TIMOTHY, GREEN
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

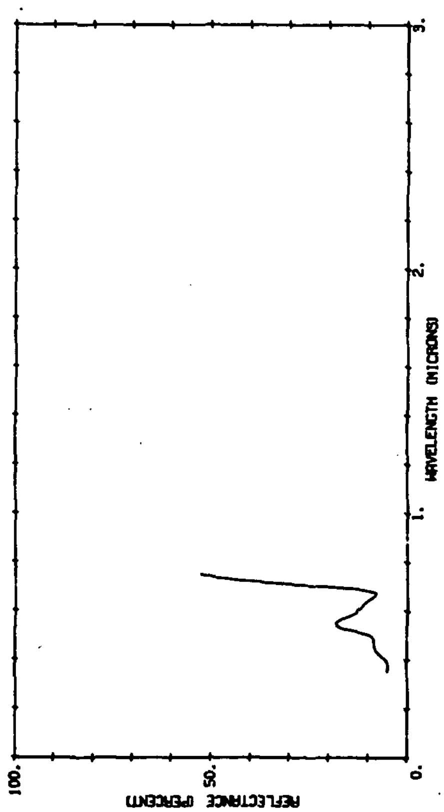

B02418 337
I.R. TIMOTHY, GREEN
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B02418 338
VIS. TALL FESCUE, GREEN, VERY COARSE
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)


B02418 339
I.R. TALL FESCUE, GREEN, VERY COARSE
REFLECTANCE (PERCENT)
100.
50.
0.
1.
2.
3.
WAVELENGTH (MICRONS)

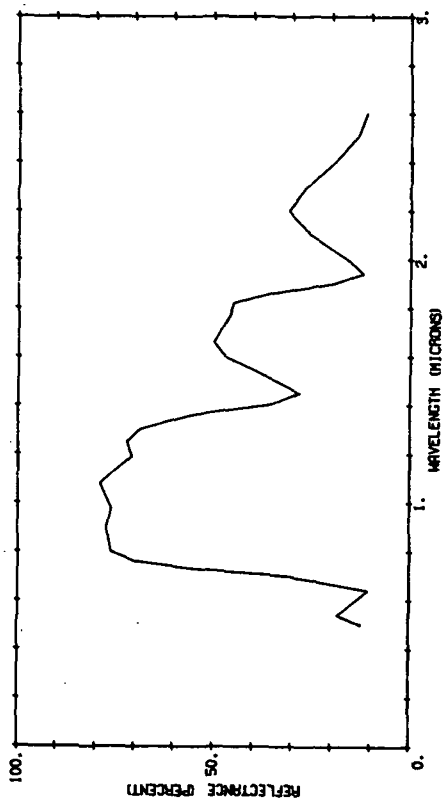
B02418 340

VIS. REED CANARY GRASS, GREEN



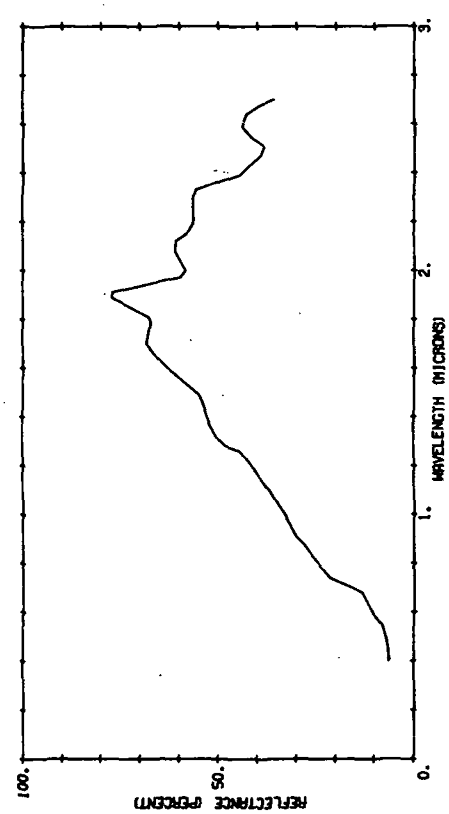
B02418 341

I.R. REED CANARY GRASS, GREEN



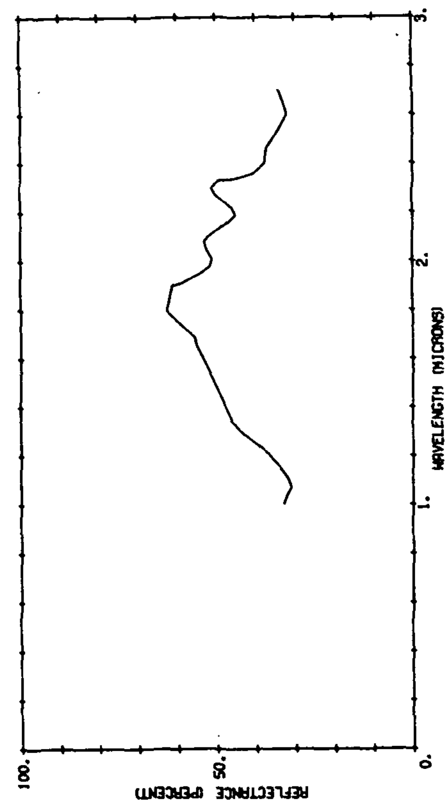
B04803 017

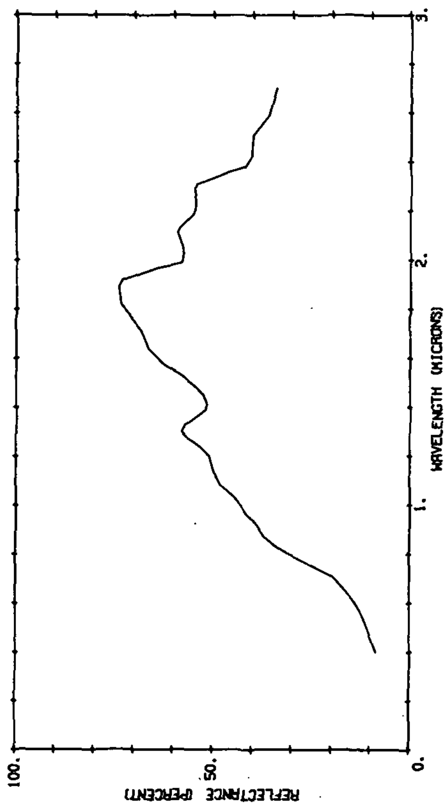
MANZANITA LEAVES, WEATHERED, LOWER LEAF SURFACE.



B04803 018

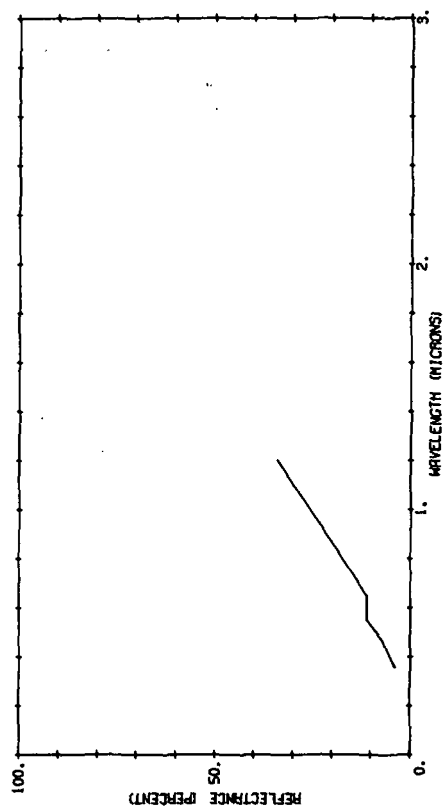
MANZANITA LEAVES, WEATHCRED, LOWER LEAF SURFACE.





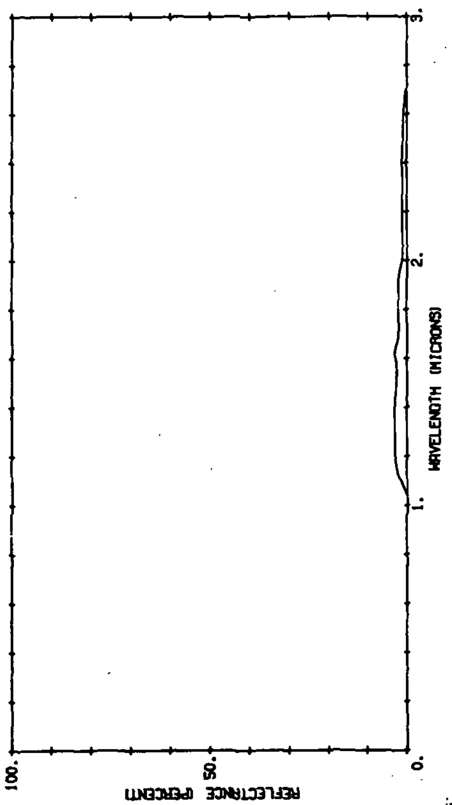
B04803 020

MANZANITA LEAVES, WEATHERED, UPPER LEAF SURFACE.



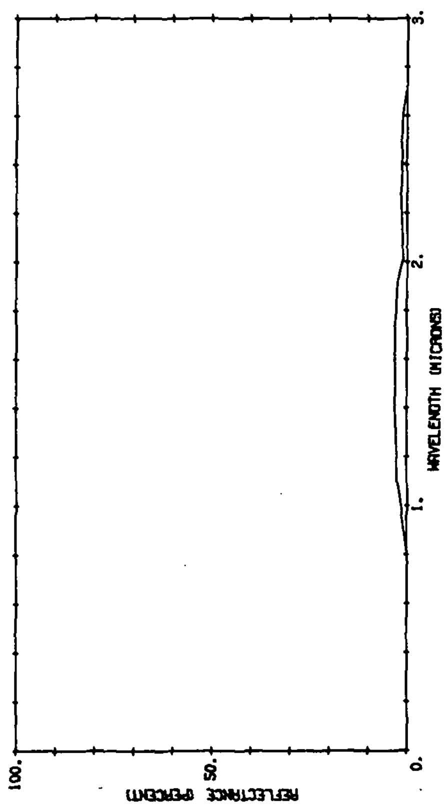
B13946 019

BEACH SAND AND GRASS, WET.



B04803 019

MANZANITA LEAVES, WEATHERED, LOWER LEAF SURFACE.

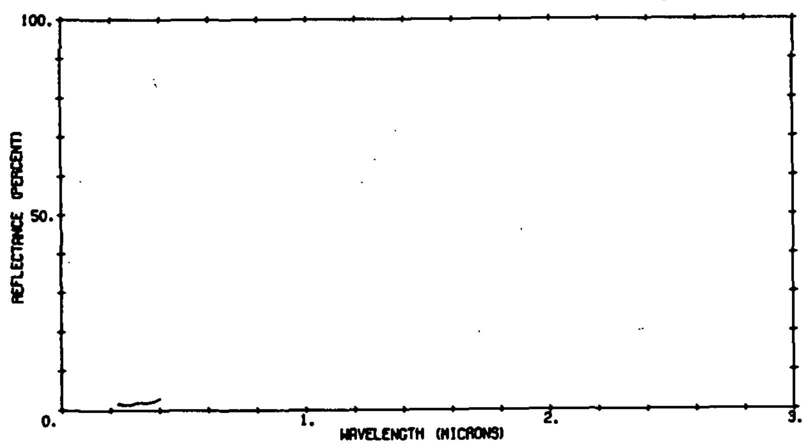


B04803 021

MANZANITA LEAVES, WEATHERED, UPPER LEAF SURFACE.

B14004 019

DEAD DRY WEEDS

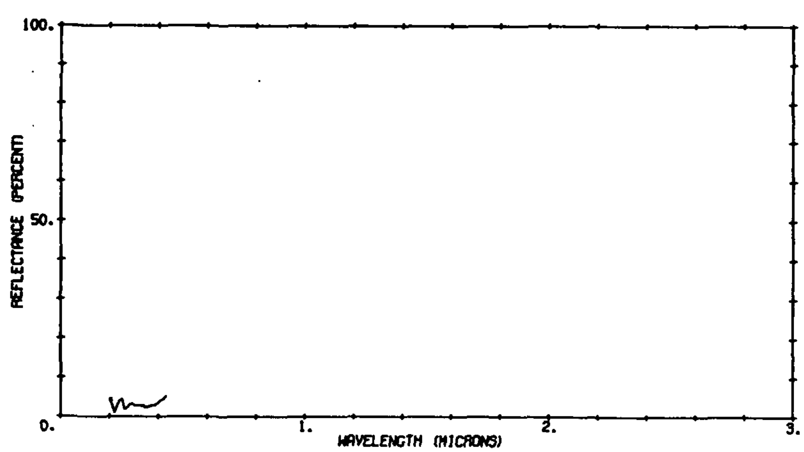


B14004 048

RICE PLANT LEAF, 2 HRS. AFTER PICKING

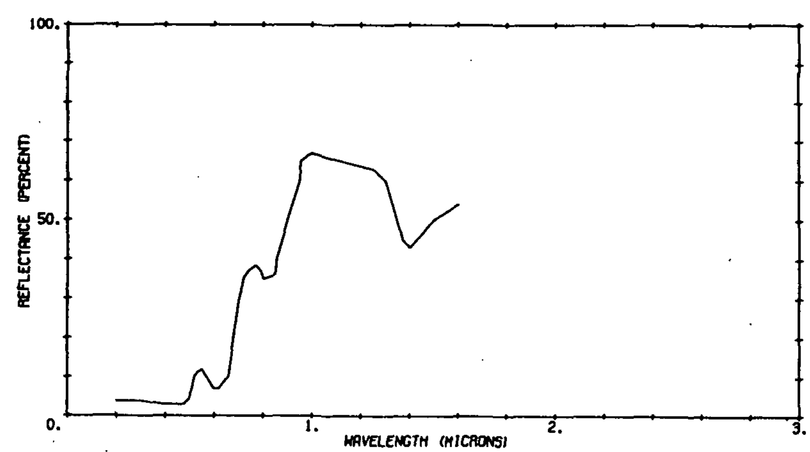
B14004 053

RICE PLANT LEAF, 2 DAYS AFTER PICKING



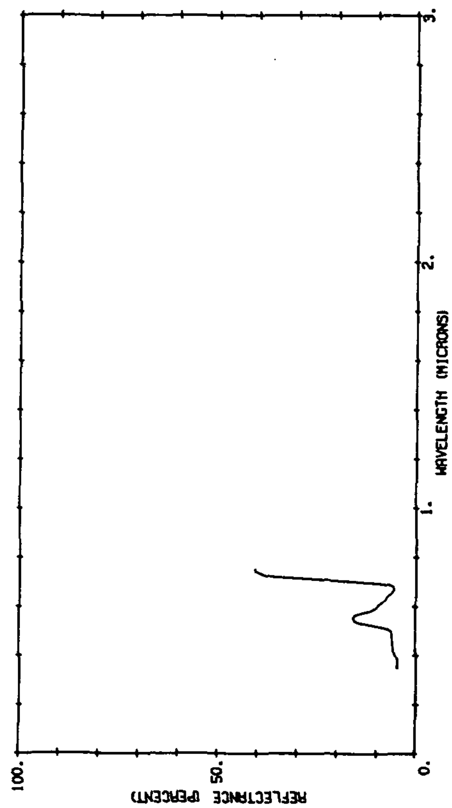
B14004 101

RICE PLANT, 3-8 HRS. AFTER PICKING



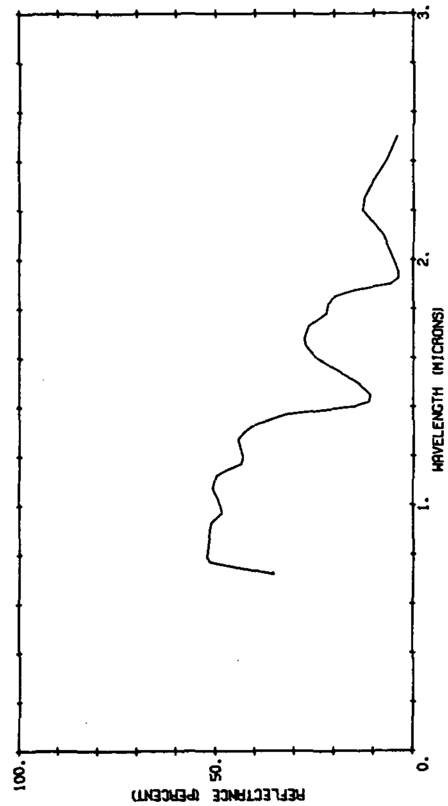
B20000 337

MINT (MENTHA), UPPER LEAF SURFACE, BEFORE PICKING.



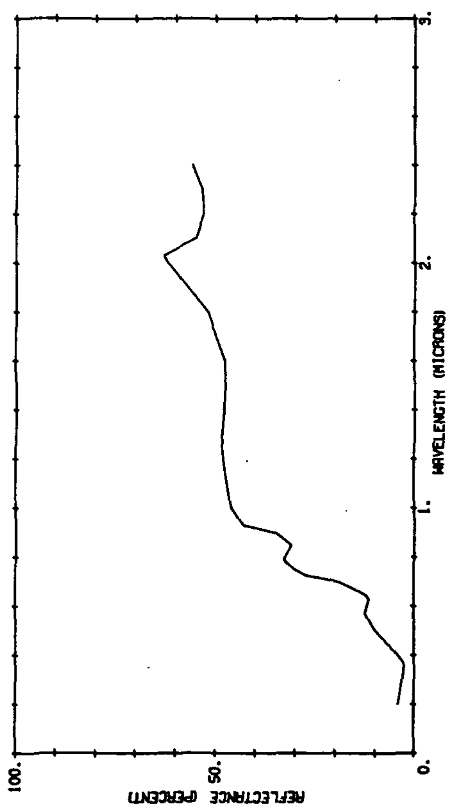
B20000 340

DRACAENA MARGINATA, UPPER LEAF SURFACE, LESS THAN 1 HOUR AFTER PICKING.



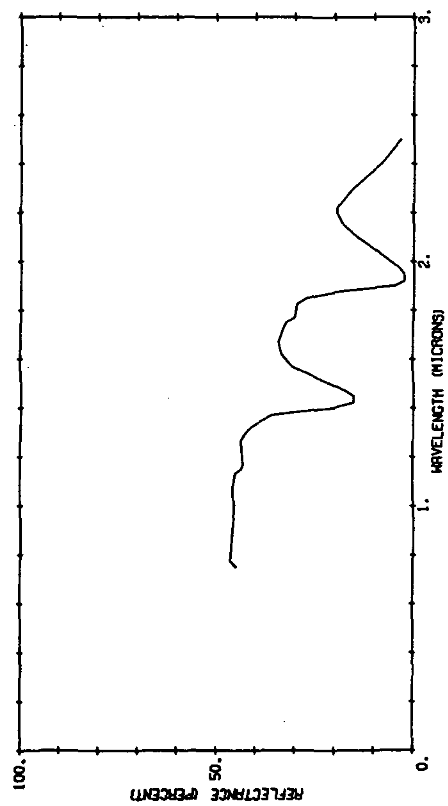
B14004 102

RICE PLANT, 3 DAYS AFTER PICKING



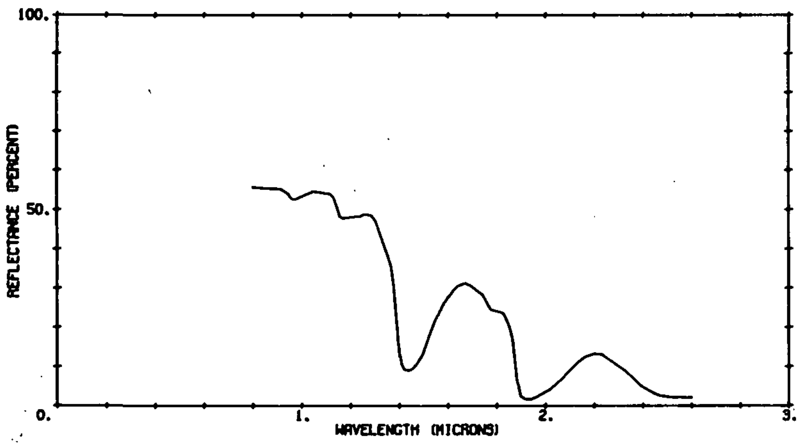
B20000 338

MINT (MENTHA), UPPER LEAF SURFACE, BEFORE PICKING.



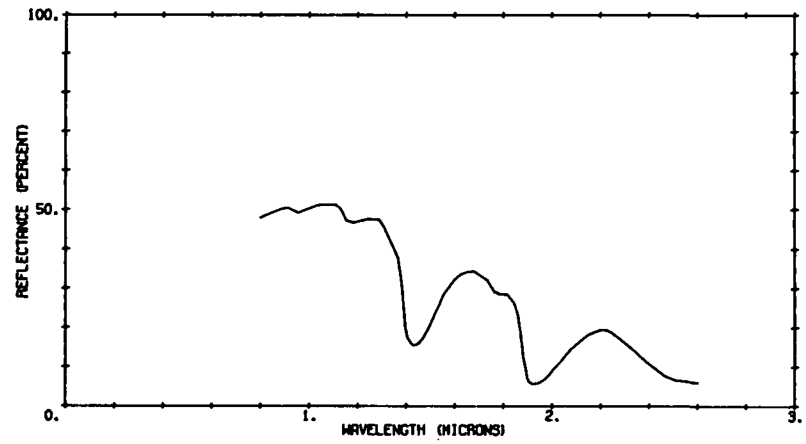
B20000 452

FERN LEAF (MARCHANTIA), UPPER LEAF SURFACE, FRESH.



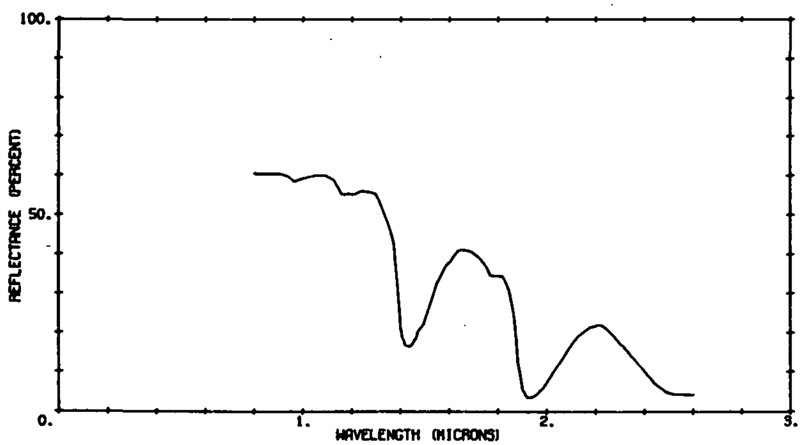
B20000 453

FERN LEAF (MARCHANTIA), LOWER LEAF SURFACE, FRESH.



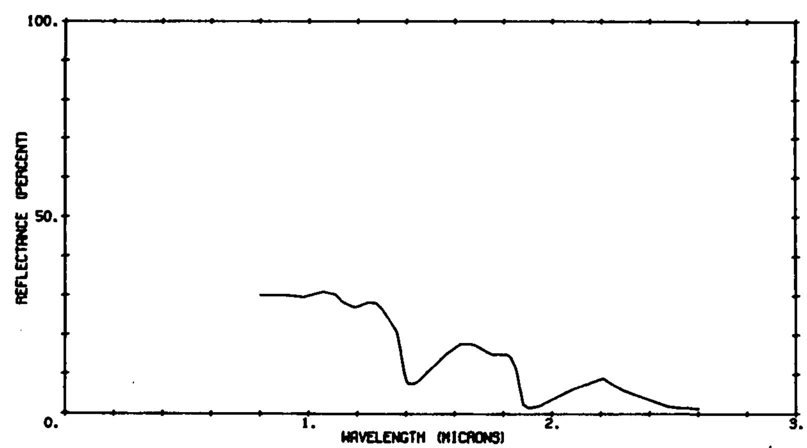
B20000 454

FERN LEAF (MARCHANTIA), UPPER LEAF SURFACE, AFTER DRYING IN AIR 4 HOURS.



B20000 539

RED CEDAR.



BGD

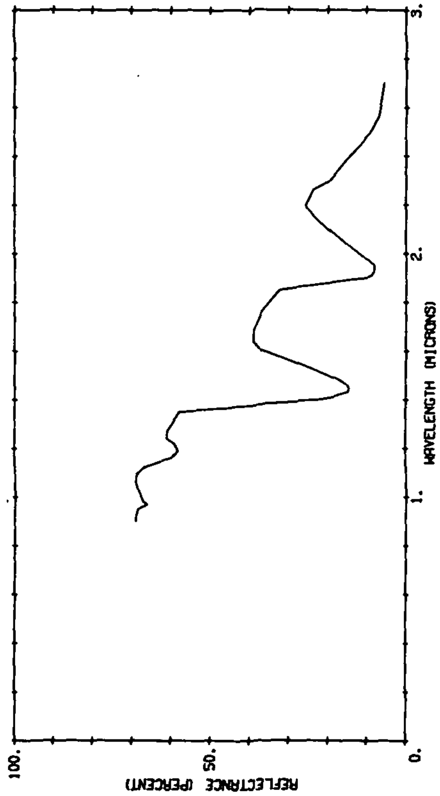
VEGETATION

Ligneous

301

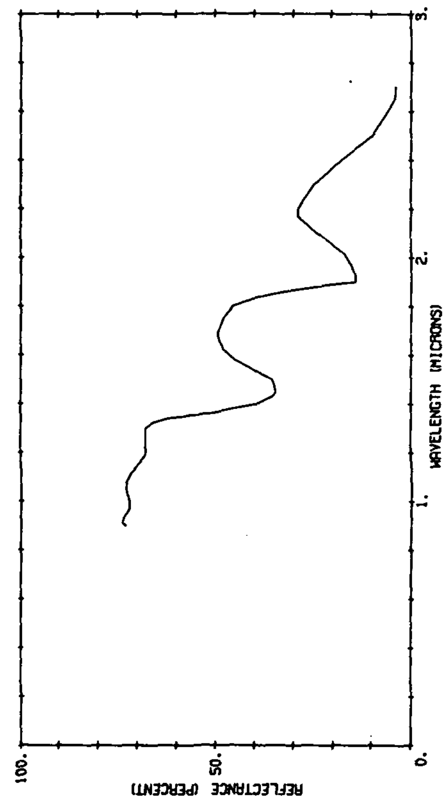
B00829 012

MAGNOLIA LEAF, TOP



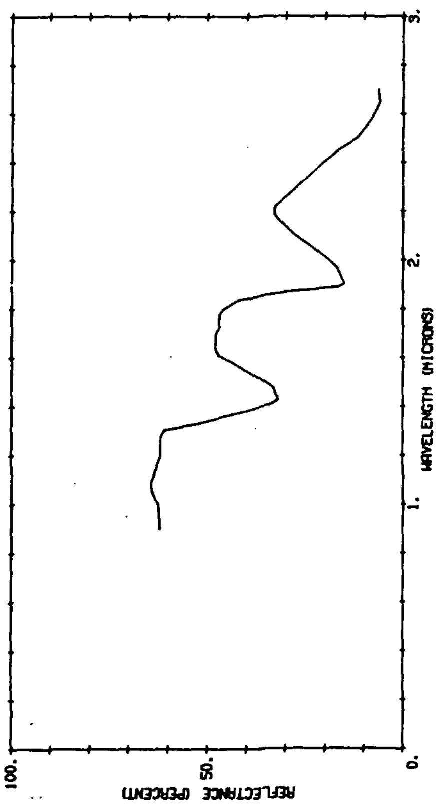
B00829 014

BLACK LOCUST LEAF, TOP



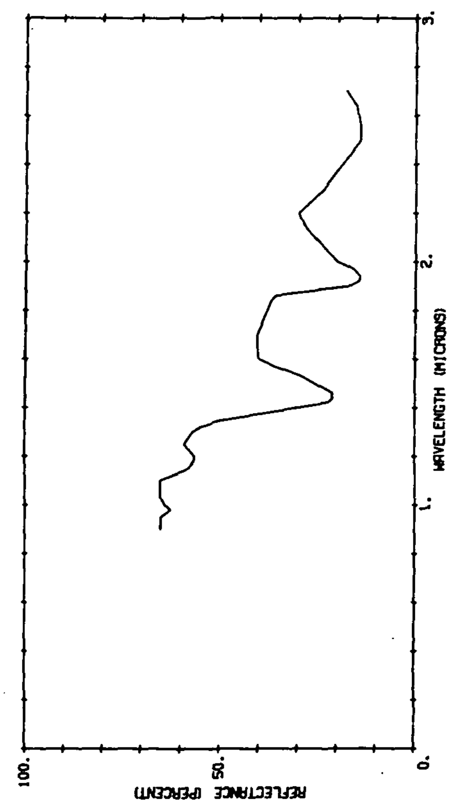
B00829 005

SASSAFRAS LEAF



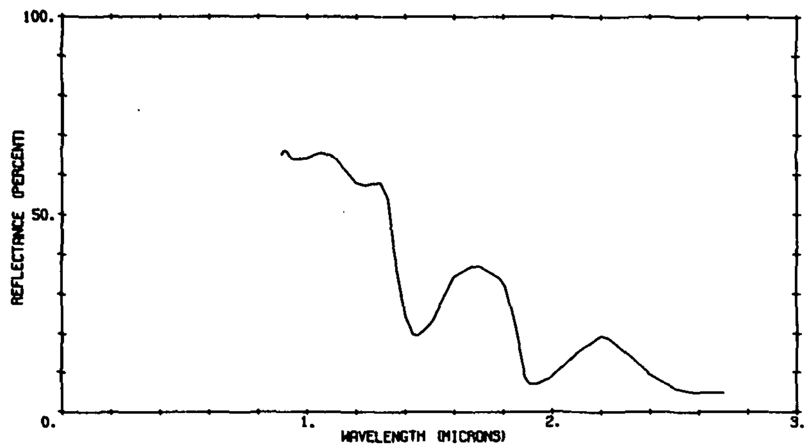
B00829 013

MAGNOLIA LEAF, BACK



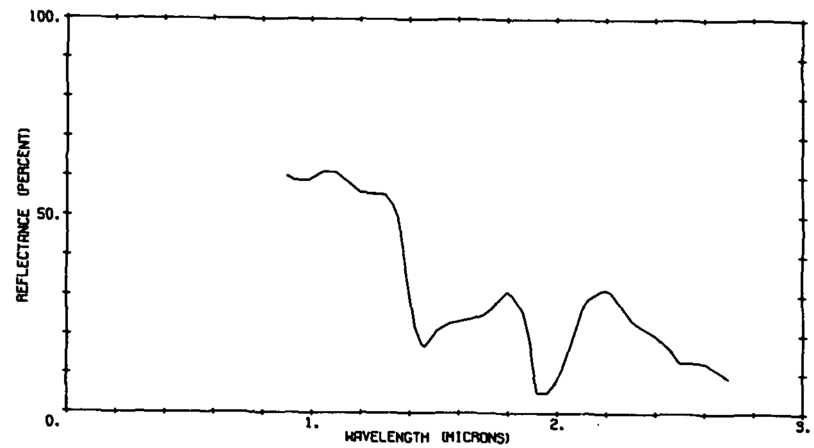
B00829 015

PAULOWINA, LEAF TOP



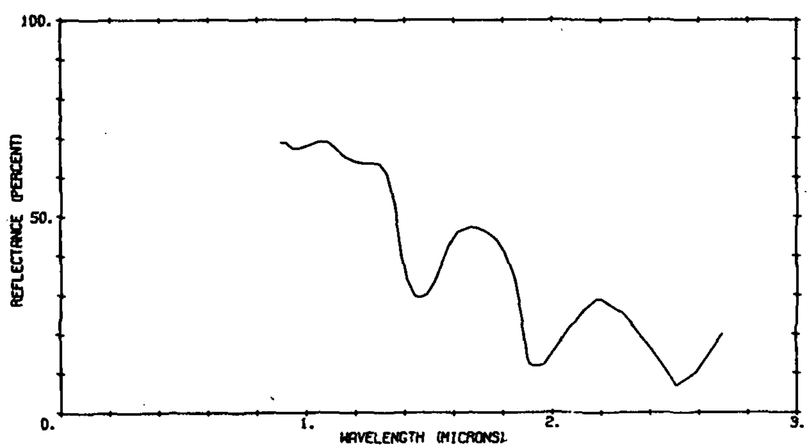
B00829 016

ILEX CRENATA (HOLLY) LEAF, TOP



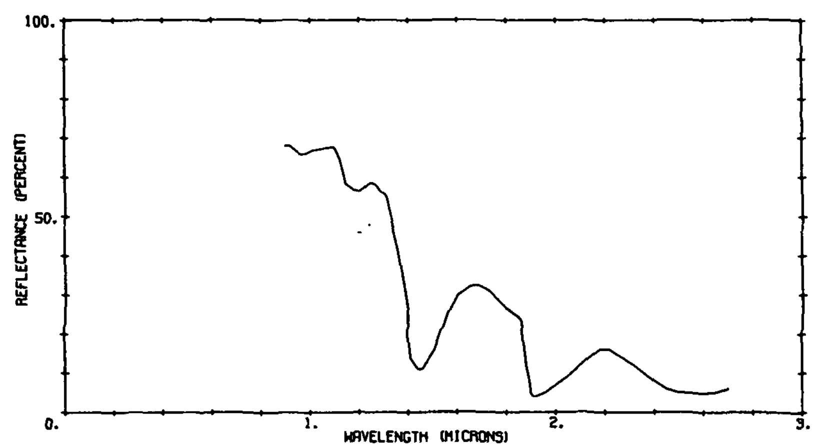
B00829 018

BLACK LOCUST LEAF, BACK



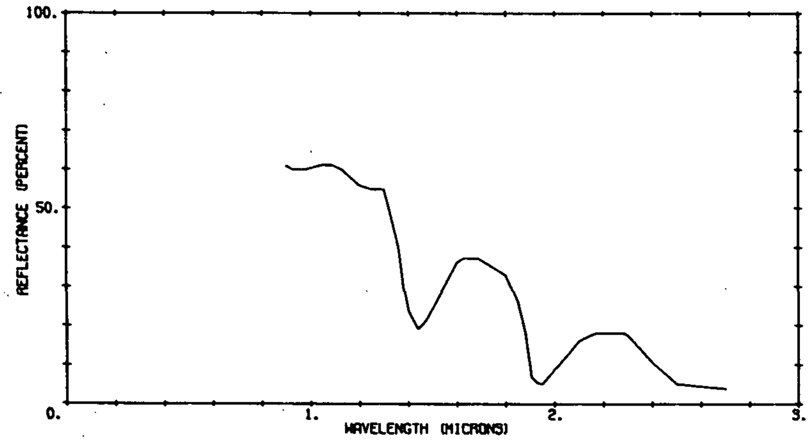
B00829 019

PRIVET HEDGE, TOP OF LEAF



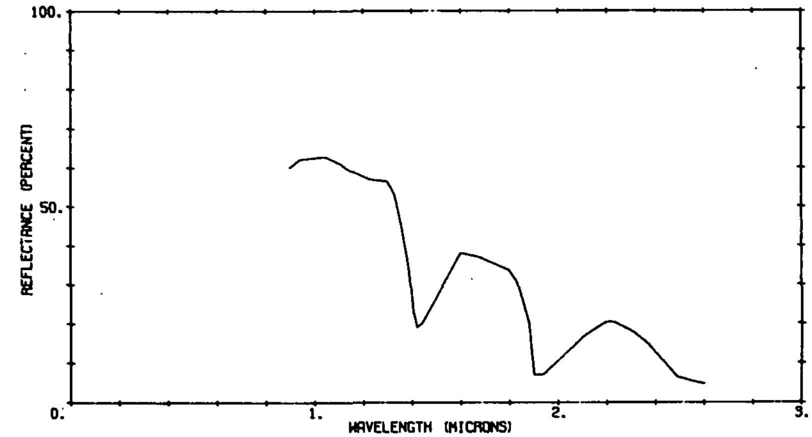
B00829 027

STAGHORN SUMACH, TOP (RED, NOT FALLEN)



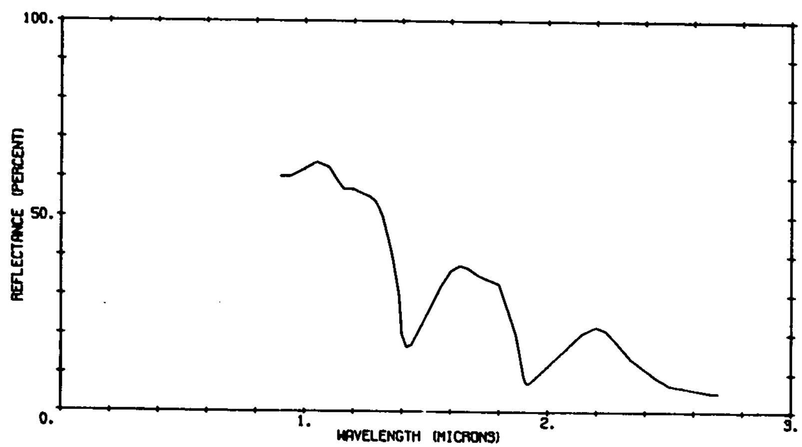
B00829 033

CHINESE PISTACHIO, FOREIGN FOLIAGE



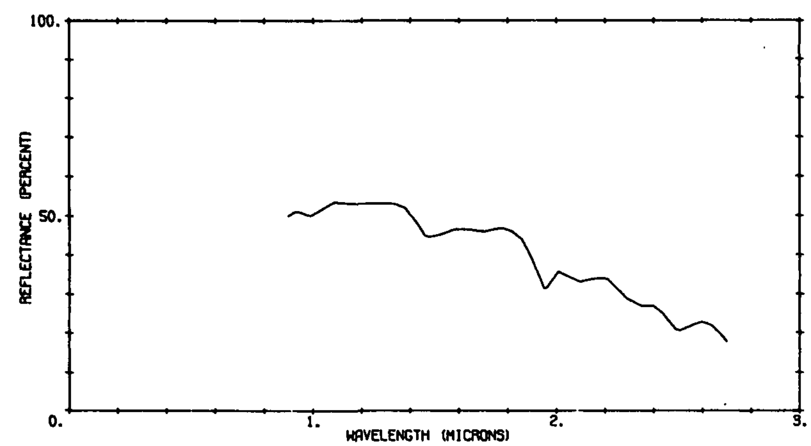
B00829 034

ARECA PALM FROM MADAGASCAR-TROPIC FOLIAGE



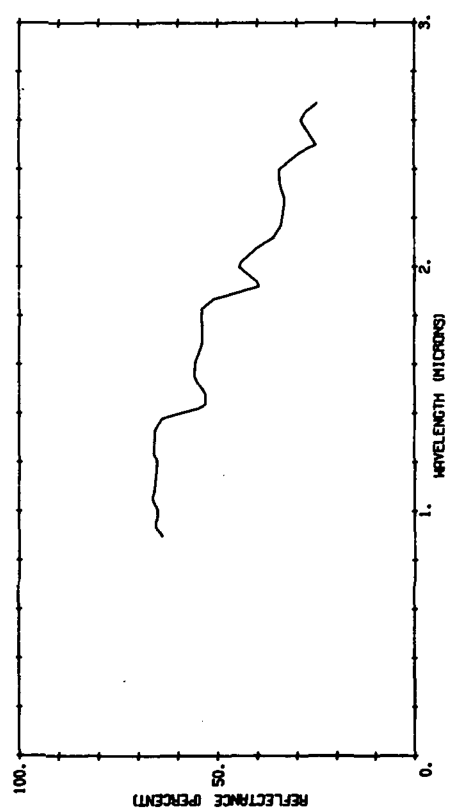
B00829 053

MERATIA PRAECOX, SHRUB, LEAF, TOP, DRY, FALLEN



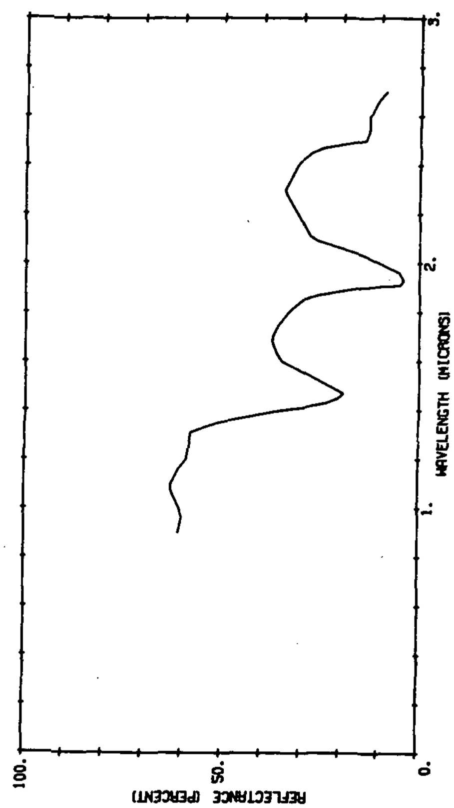
B00829 058

SUMACH LEAF, TOP, DRY, RED, FALLEN



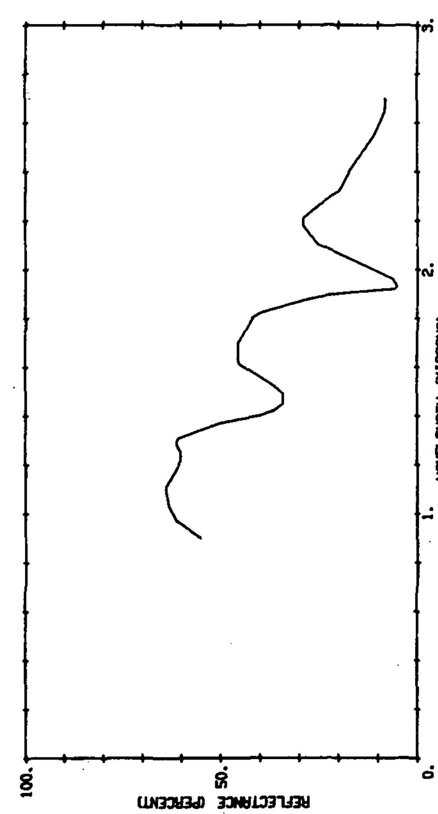
B00829 059

LIGUSTRUM SHRUB, GREEN LEAF



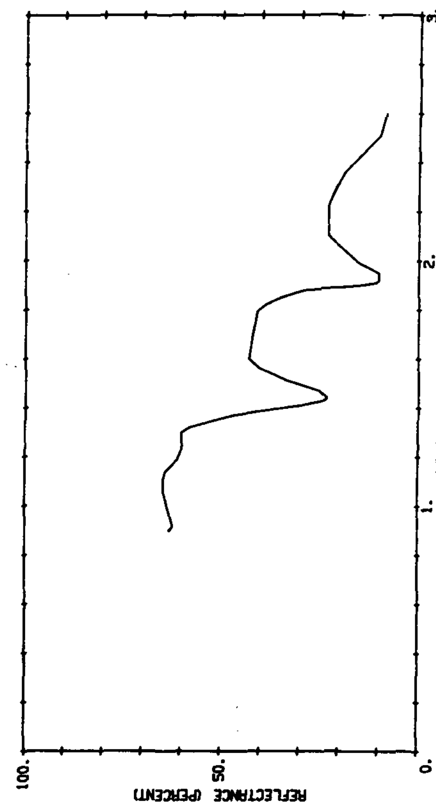
B00829 091

GOLDEN ROD (COMMON) LEAF, TOP



B00829 100

VIBURNUM, LEAF TOP

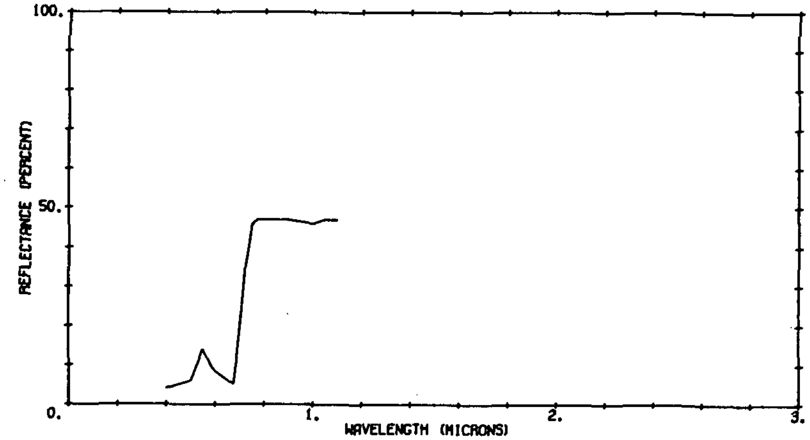


B01049 003

SYMPHORICARPOS ALBUS

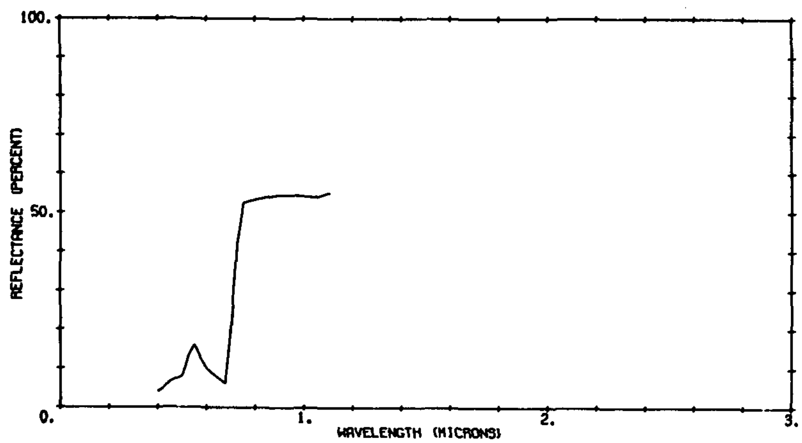
B01049 004

SYRINGA VULGARIS



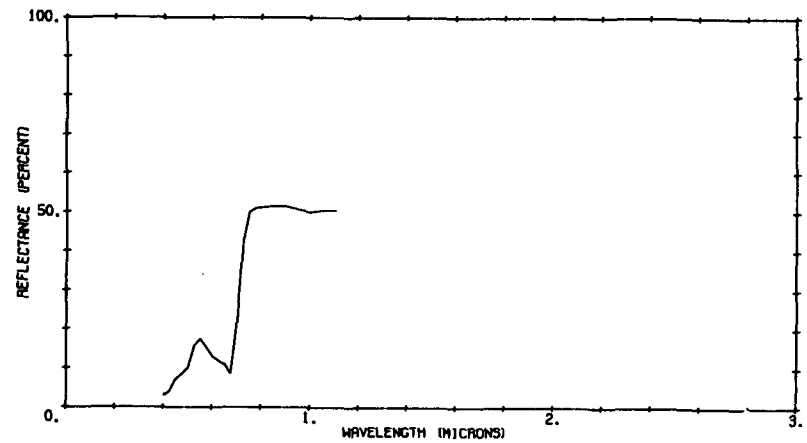
B01049 008

SYMPHORICARPOS MOLLIS



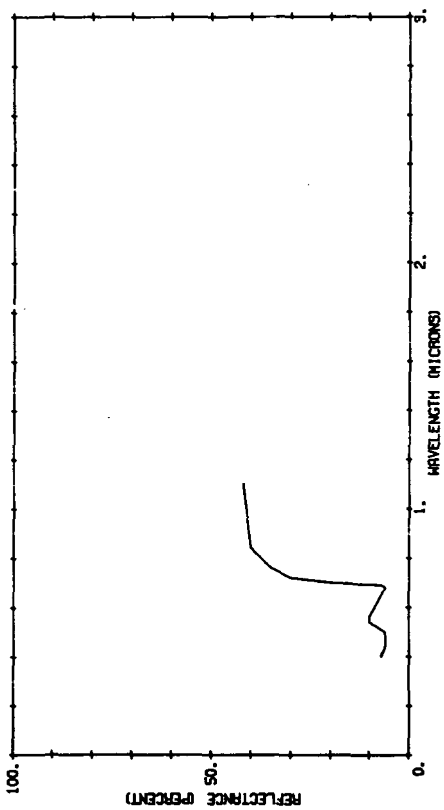
B01049 009

ARCTOSTAPHYLOS PATULA



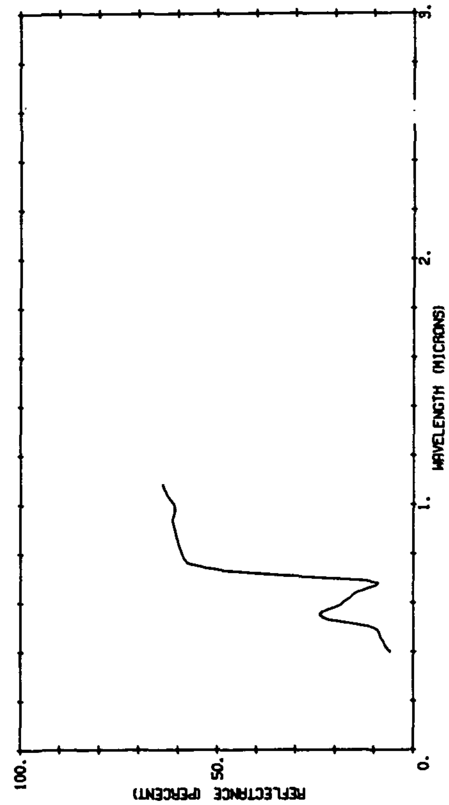
B01176 042

NATURAL LAUREL LEAVES, UNPAINTED



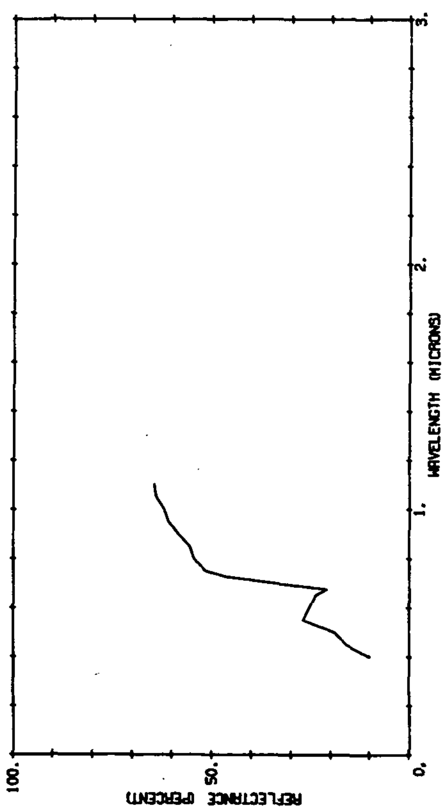
B01367 006

LEAF, IN CONTAINER 17 HOURS, MOUNTAIN LAUREL, DORSAL SIDE



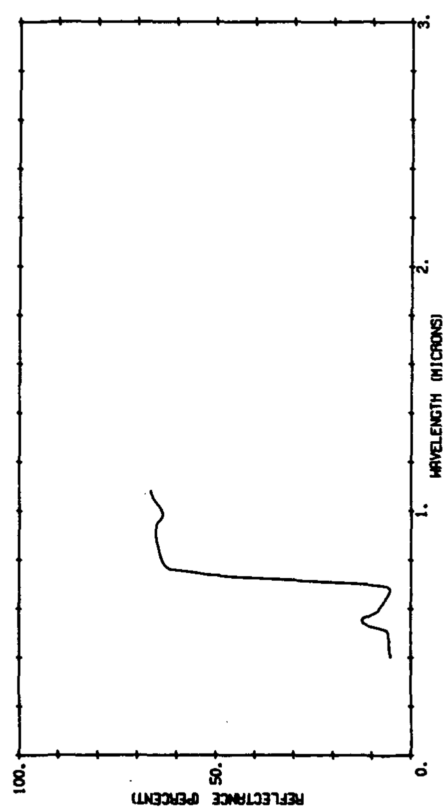
B01049 013

ARTEMISIA TRIDENTATA



B01367 005

LEAF, IN CONTAINER 17 HOURS, MOUNTAIN LAUREL, VENTRAL SIDE

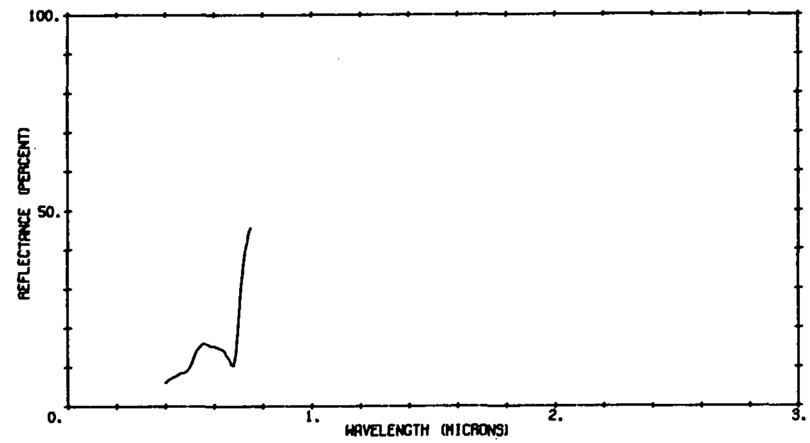


B01368 040

LEAF, IRONWOOD, VENTRAL

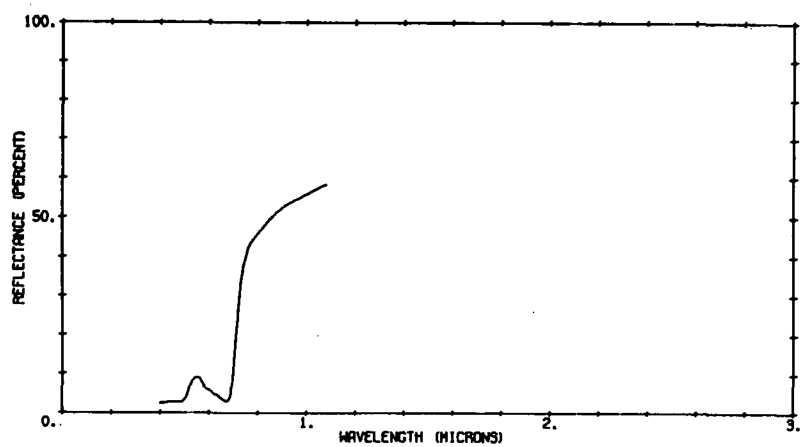
B01368 041

LEAF, IRONWOOD, DORSAL



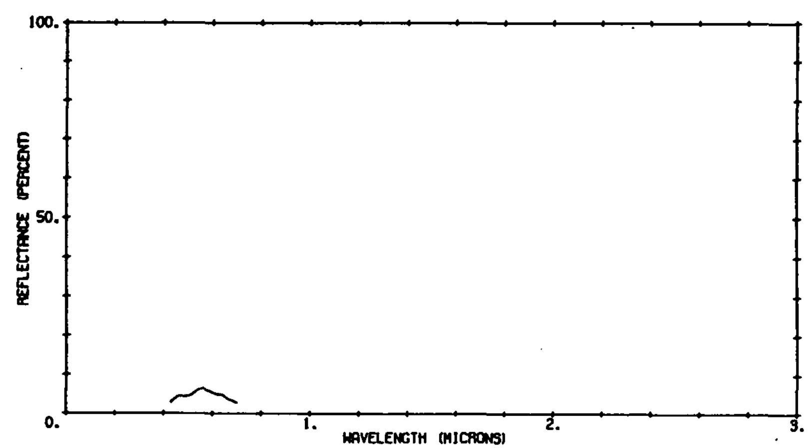
B01368 062

LEAF, HORNBEAM, VENTRAL SIDE



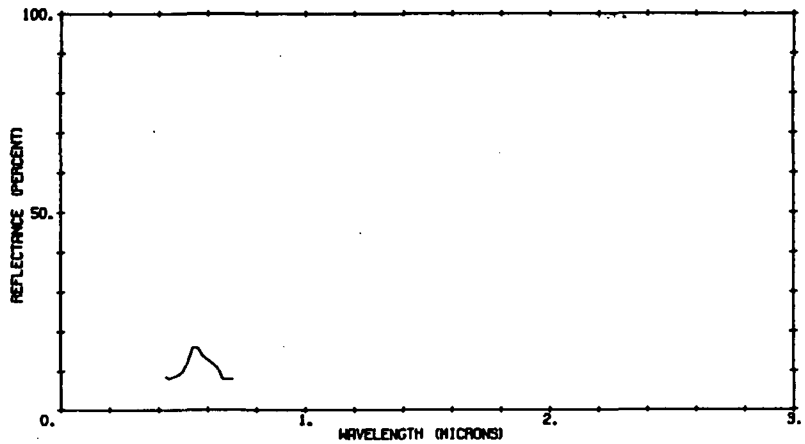
B01761 009

LILAC, SYRINGA VULGARIS, UPPER LEAF SURFACE.



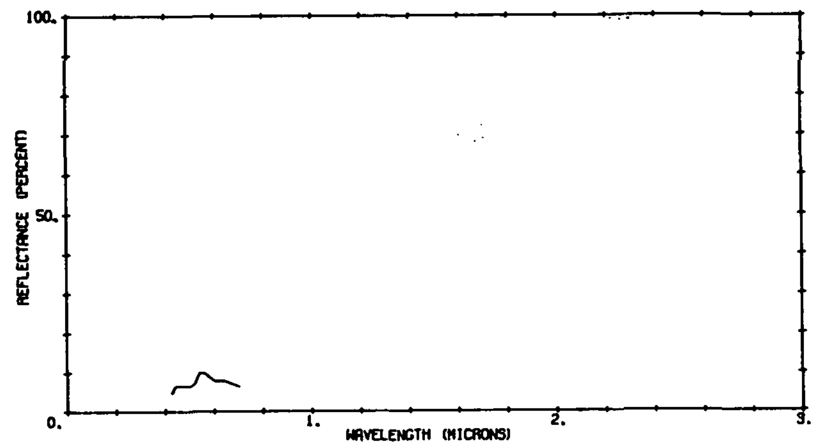
B01761 010

LILAC, SYRINGA VULGARIS, LOWER LEAF SURFACE.



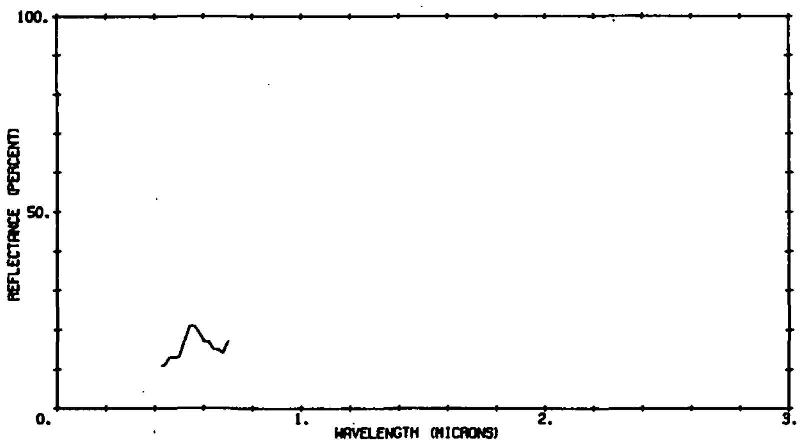
B01761 011

LILAC, SYRINGA VULGARIS, UPPER LEAF SURFACE.



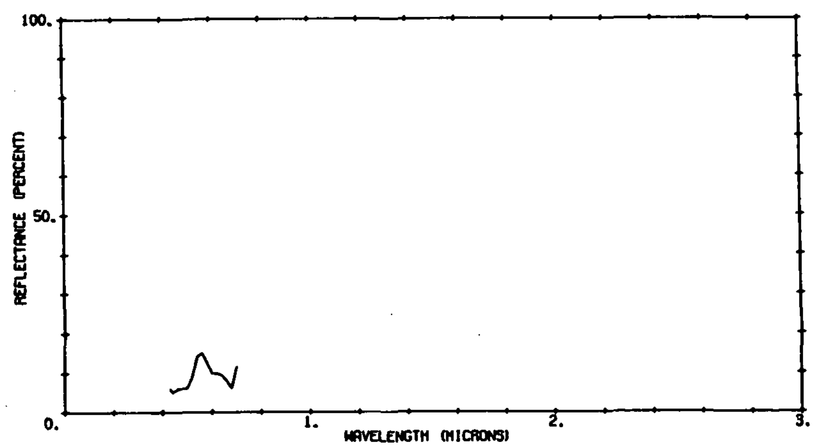
B01761 012

LILAC, SYRINGA VULGARIS, LOWER LEAF SURFACE.



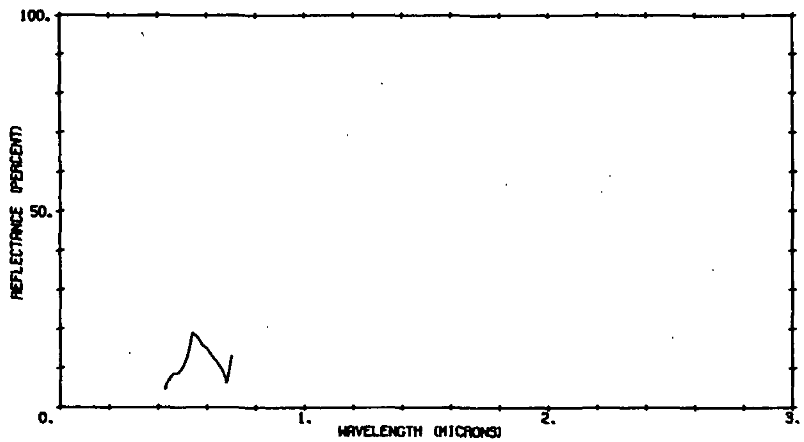
B01761 013

GINKGO BILOBA, UPPER LEAF SURFACE.



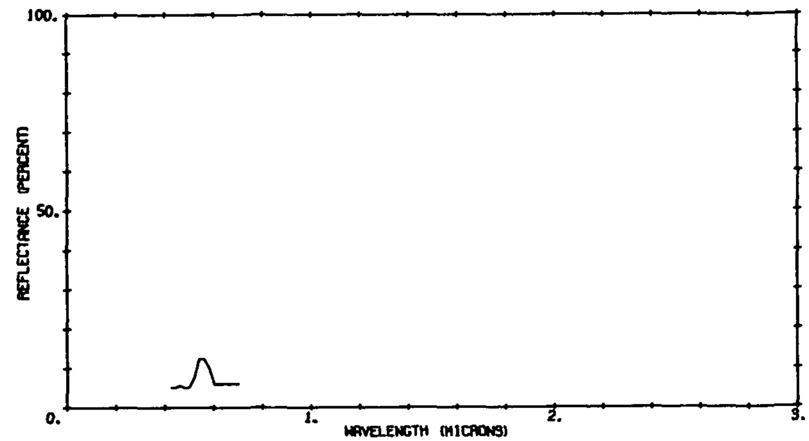
B01761 014

GINKGO BILOBA, LOWER LEAF SURFACE.



B01761 015

MAGNOLIA, MAGNOLIA ACUMINATA, UPPER LEAF SURFACE.

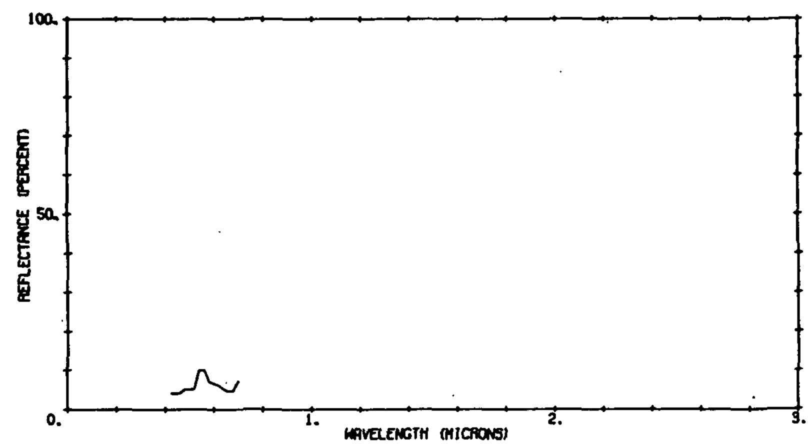


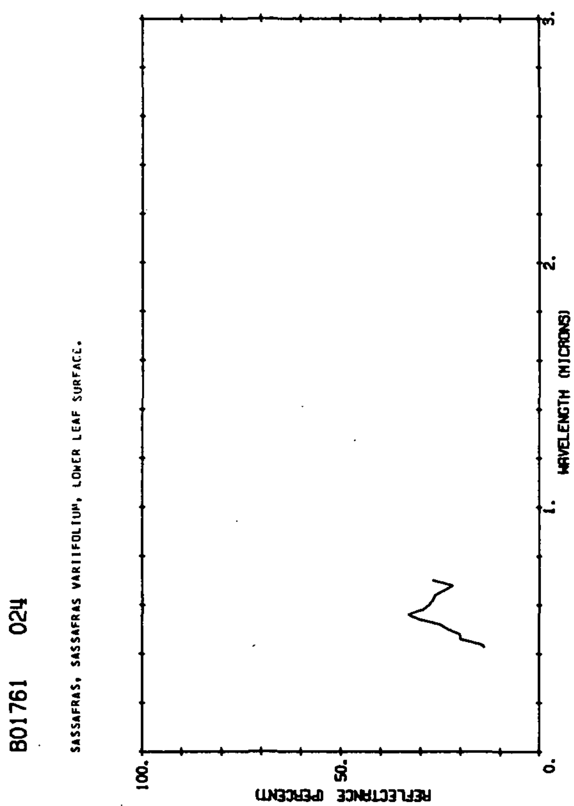
B01761 016

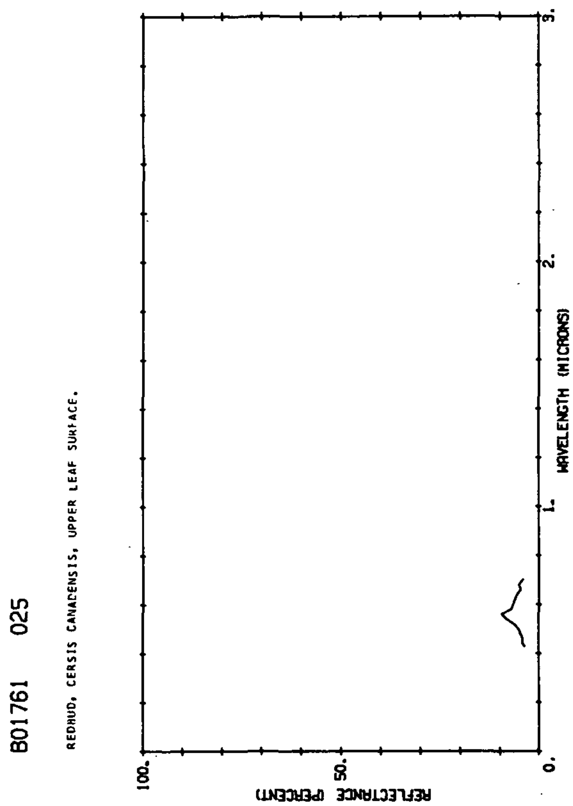
MAGNOLIA, MAGNOLIA ACUMINATA, LOWER LEAF SURFACE.

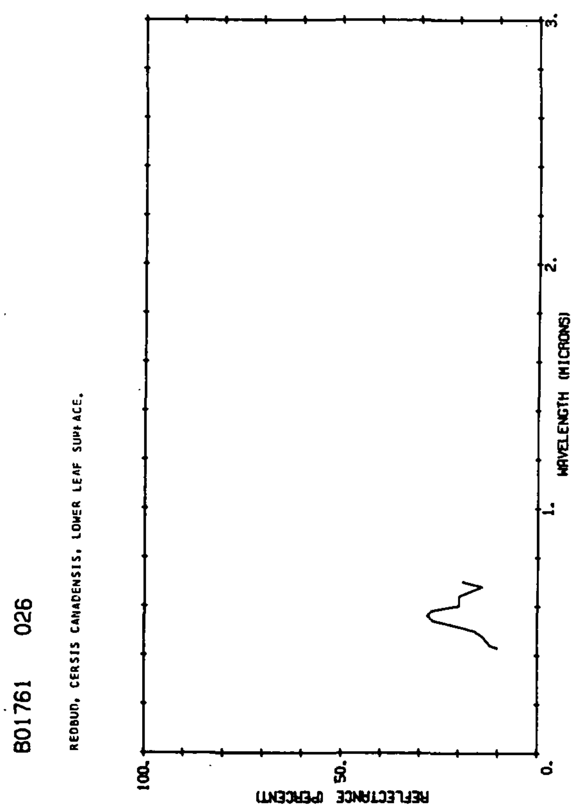
B01761 023

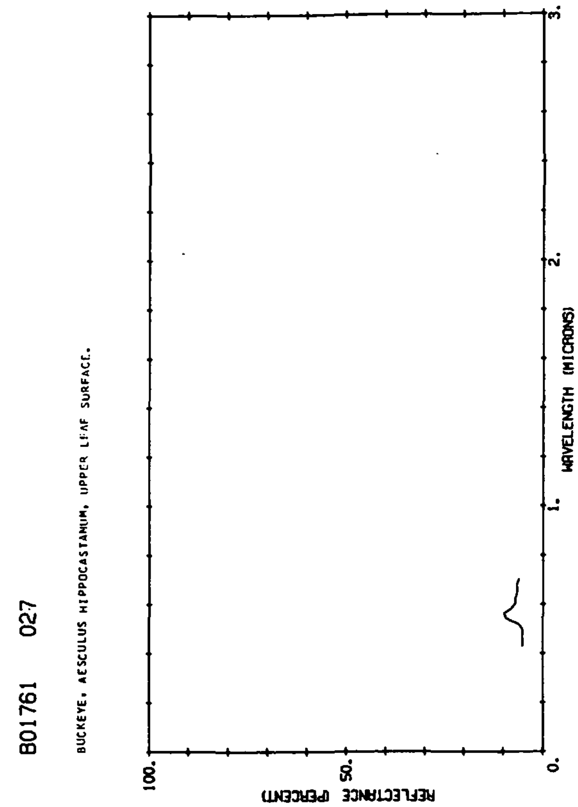
SASSAFRAS, SASSAFRAS VARIIFOLIUM, UPPER LEAF SURFACE.




B01761 024
SASSAFRAS, SASSAFRAS VARIIFOLIUM, LOWER LEAF SURFACE.
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

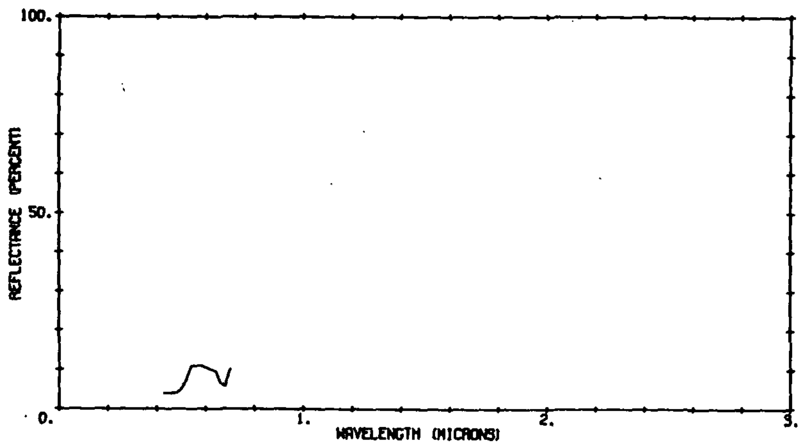

B01761 025
REDBUD, CERSIS CANADENSIS, UPPER LEAF SURFACE.
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B01761 026
REDBUD, CERSIS CANADENSIS, LOWER LEAF SURFACE.
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B01761 027
BUCKEYE, AESCULUS HIPPOCASTANUM, UPPER LEAF SURFACE.
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

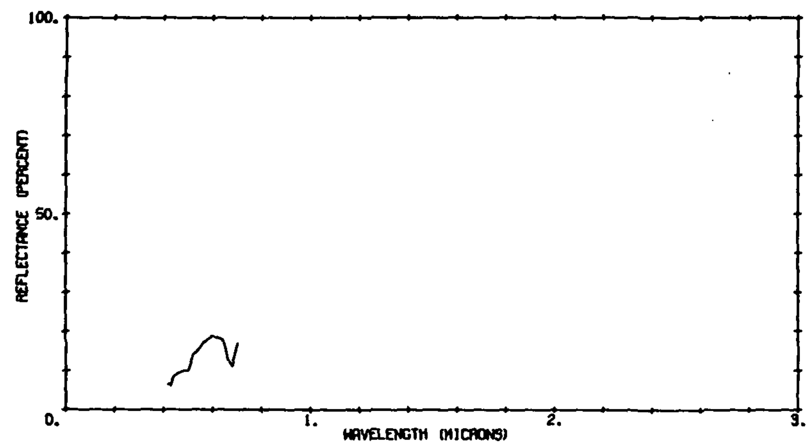
B01761 042

RUBBER PLANT, FICUS ELASTICA, YOUNG, UPPER LEAF SURFACE.



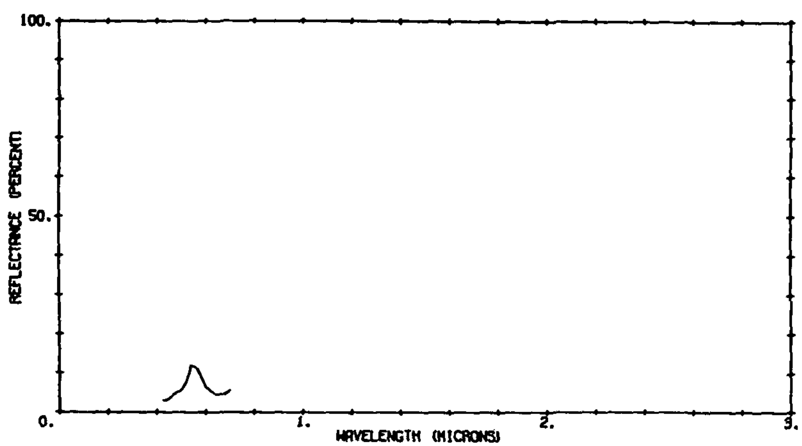
B01761 043

RUBBER PLANT, FICUS ELASTICA, YOUNG, LOWER LEAF SURFACE.



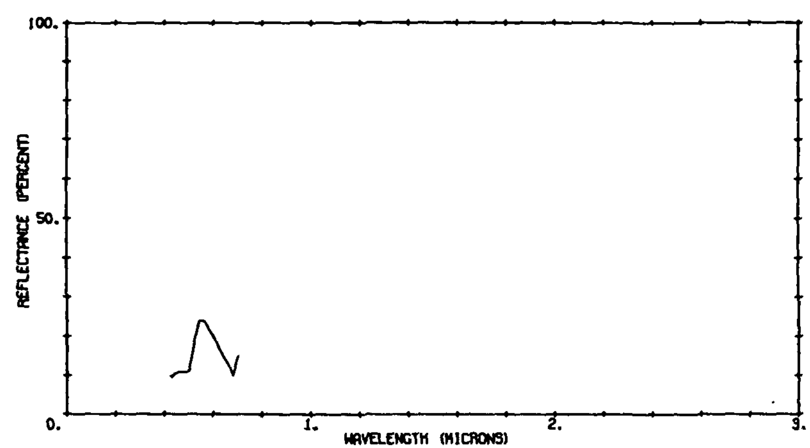
B01761 044

RUBBER PLANT, FICUS ELASTICA, OLD, UPPER LEAF SURFACE.



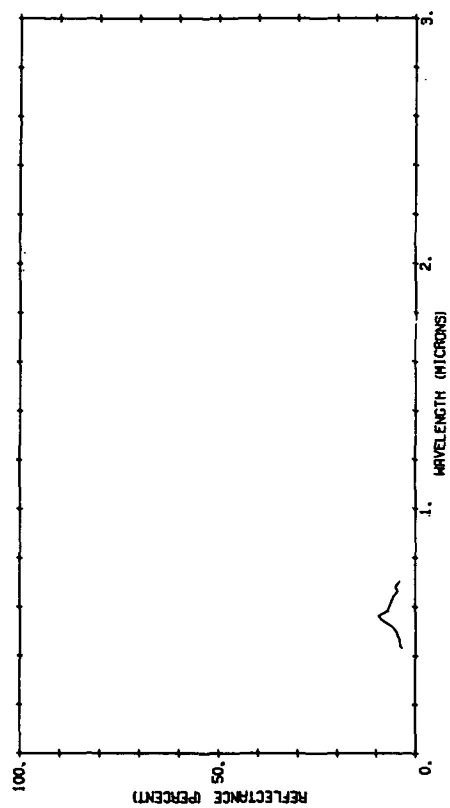
B01761 045

RUBBER PLANT, FICUS ELASTICA, OLD, LOWER LEAF SURFACE.



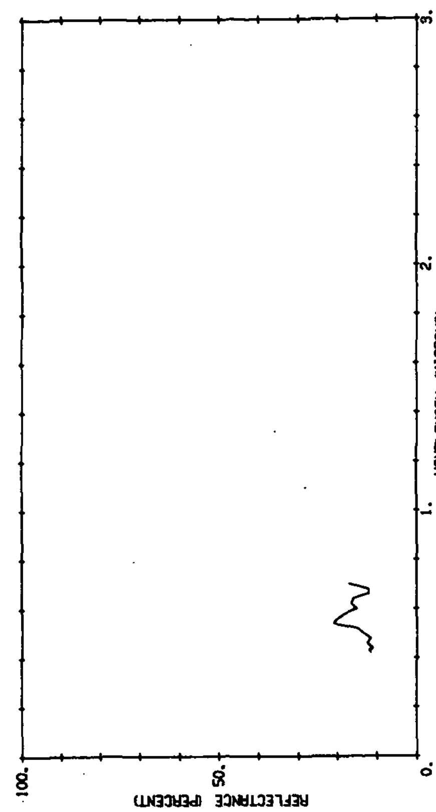
B01761 047

REDBUD, CERSIS CANADENSIS, OLD, UPPER LEAF SURFACE.



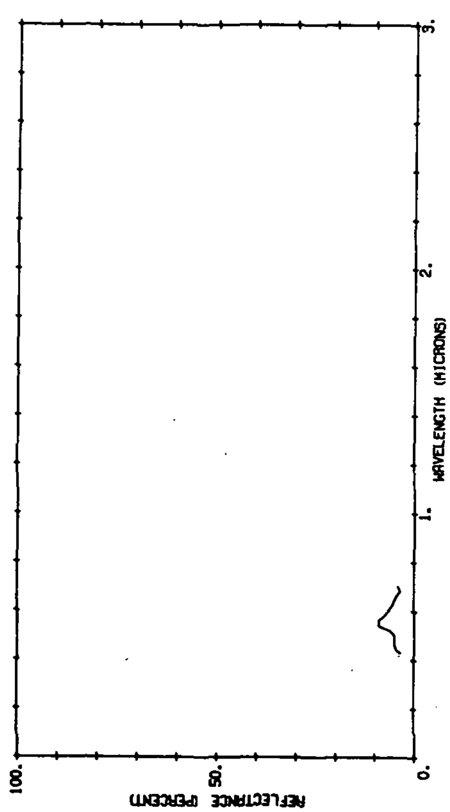
B01761 049

MULLEIN, VERBASCUM THAPSUS, LOWER LEAF SURFACE.



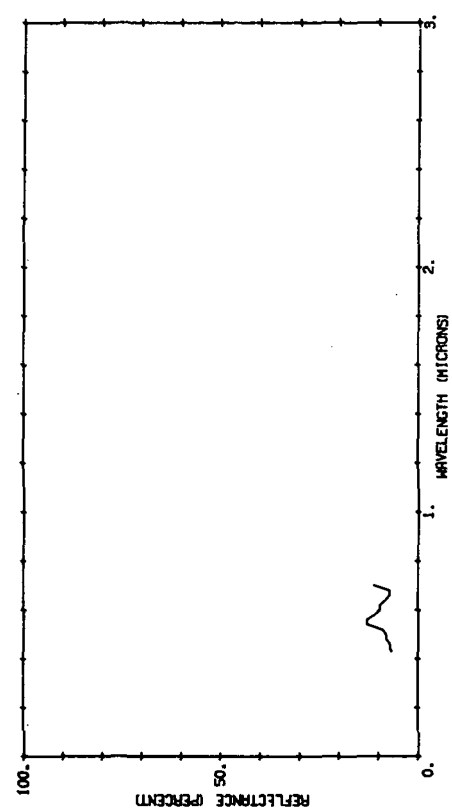
B01761 046

REDBUD, CERSIS CANADENSIS, YOUNG, UPPER LEAF SURFACE.



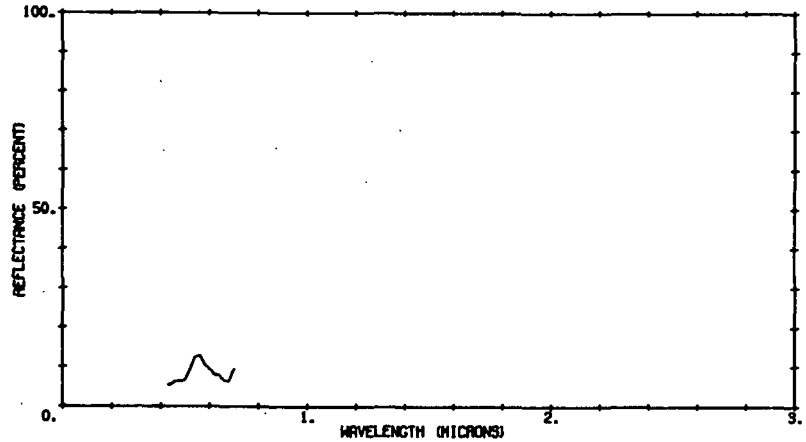
B01761 048

MULLEIN, VERBASCUM THAPSUS, UPPER LEAF SURFACE.



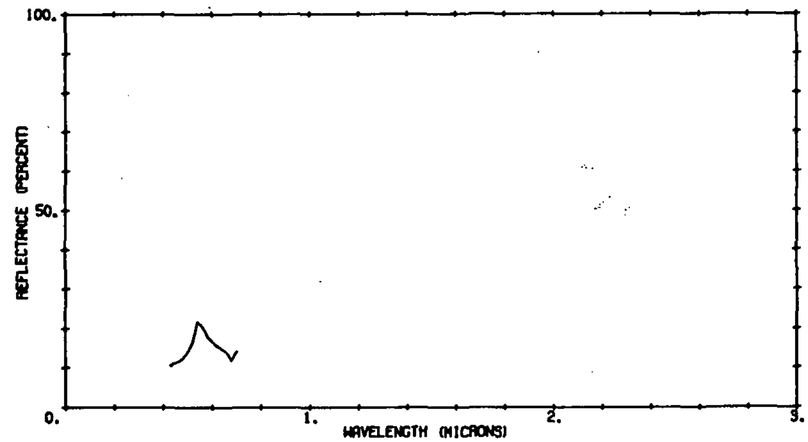
B01761 050

MULLEIN, VERBASCUM THAPSUS, UPPER LEAF SURFACE.



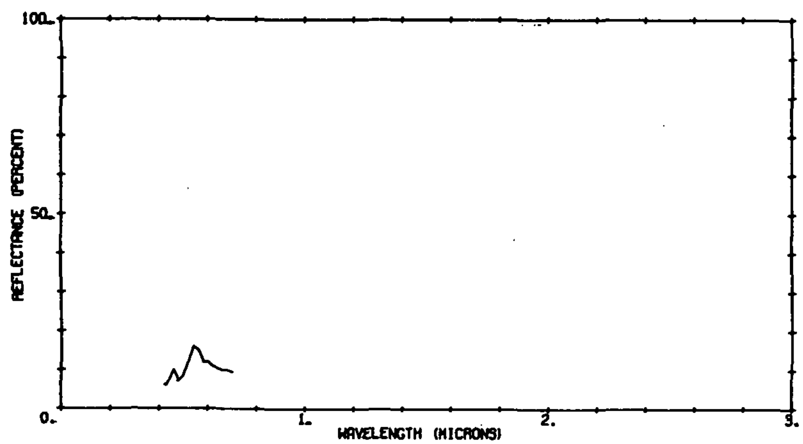
B01761 051

MULLEIN, VERBASCUM THAPSUS, LOWER LEAF SURFACE.



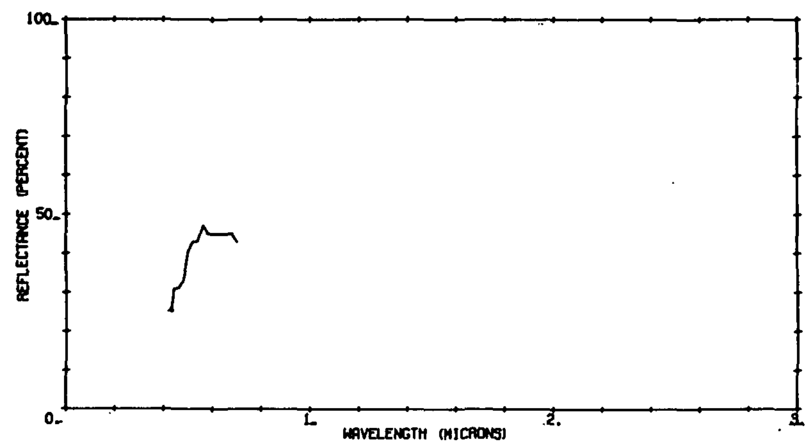
B01761 058

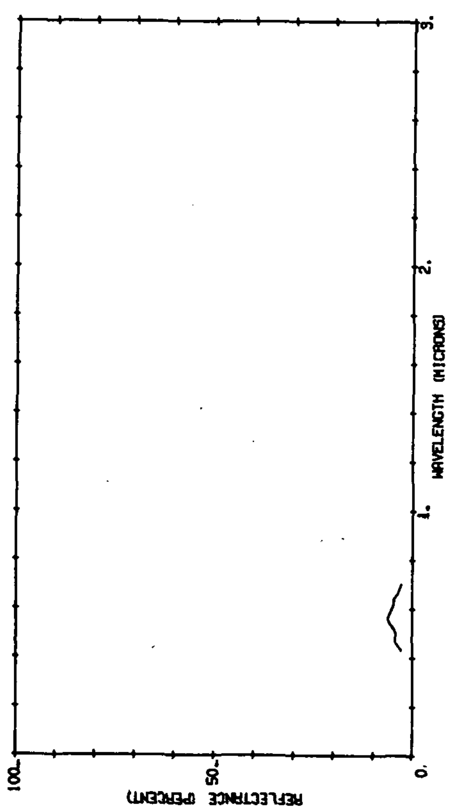
GREEN GERANIUM, UPPER LEAF SURFACE.



B01761 059

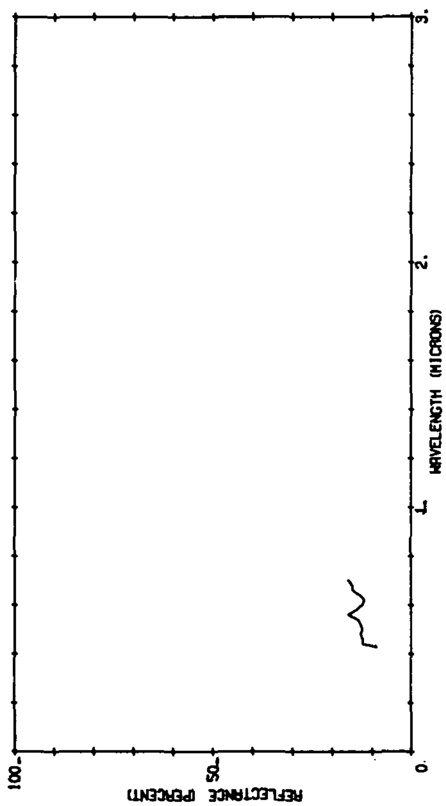
ALBINO GERANIUM, UPPER LEAF SURFACE.





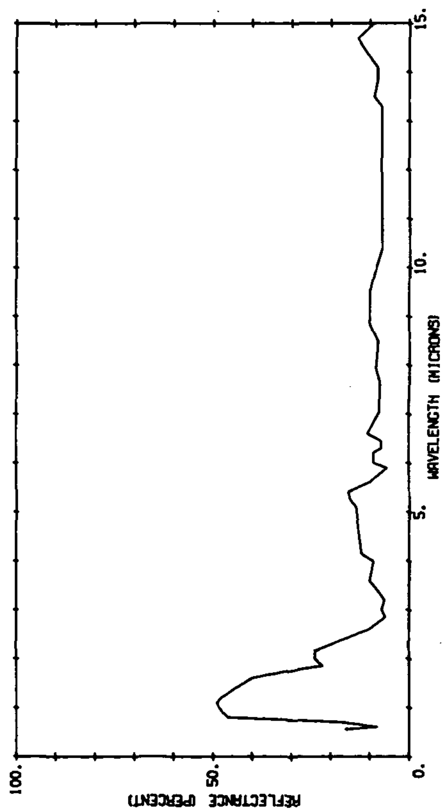
B01761 060

LILAC, SYRINGA VULGARIS, HEALTHY, UPPER LEAF SURFACE.



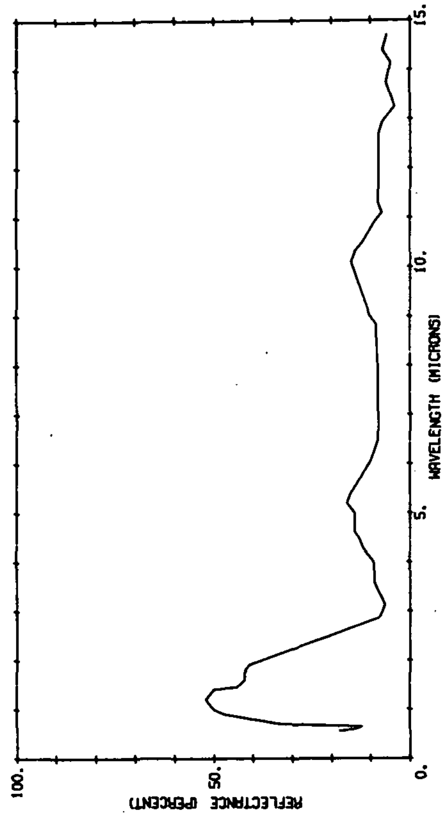
B01761 061

LILAC, SYRINGA VULGARIS, MILDEWED, UPPER LEAF SURFACE.



B01818 008

LAUREL, MOUNTAIN, GREEN (KALMIA LATIFOLIA)

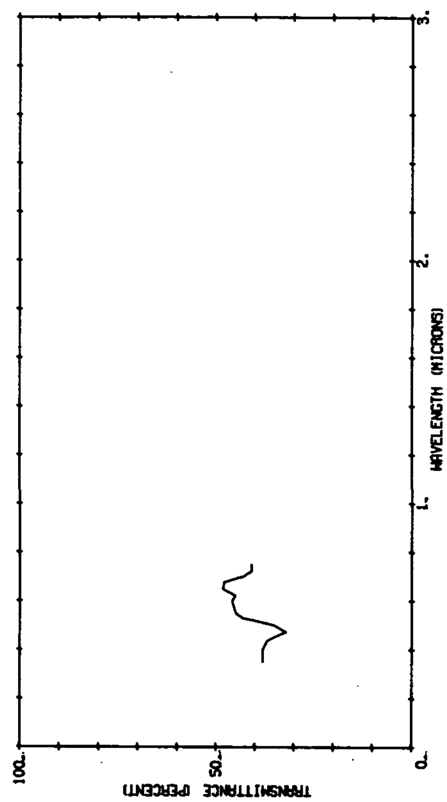


B01818 010

HOLLY LEAF, TOP (ILEX ALTACLARENSIS) DRY

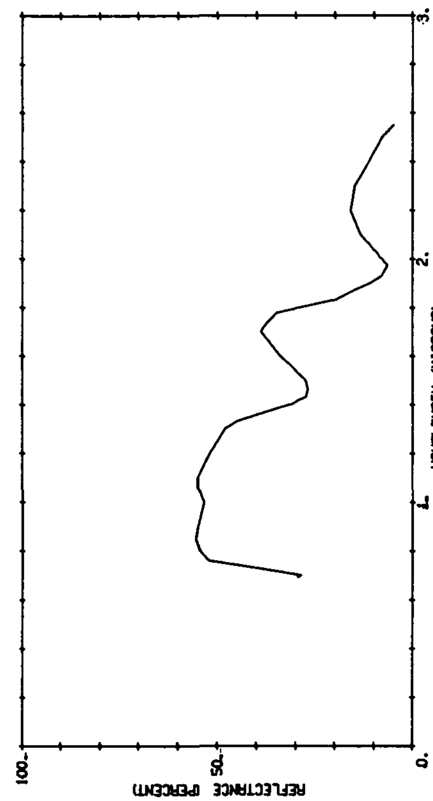
B01948 006

COLEUS, WHITE LEAF.



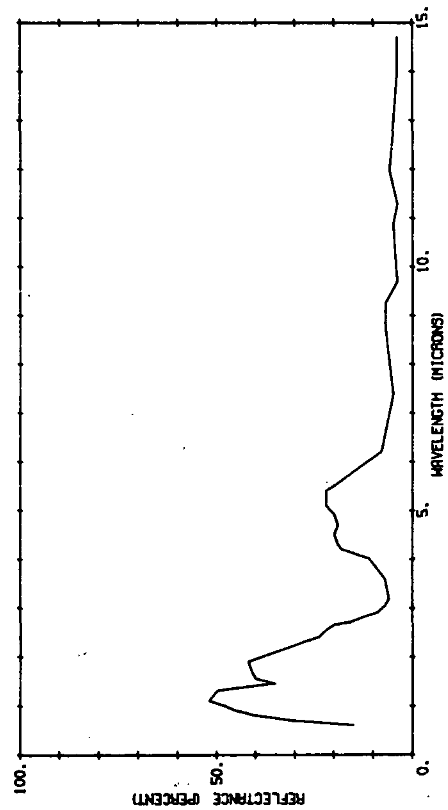
B01948 008

RUBBER PLANT, FICUS ELASTICA, LOWER LEAF SURFACE.



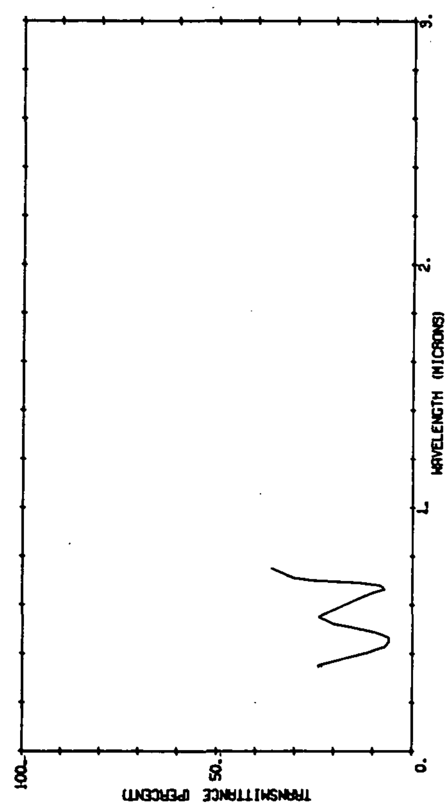
B01818 011

HOLLY LEAF, BOTTOM (ILEX ALTACLARENSIS) DRY



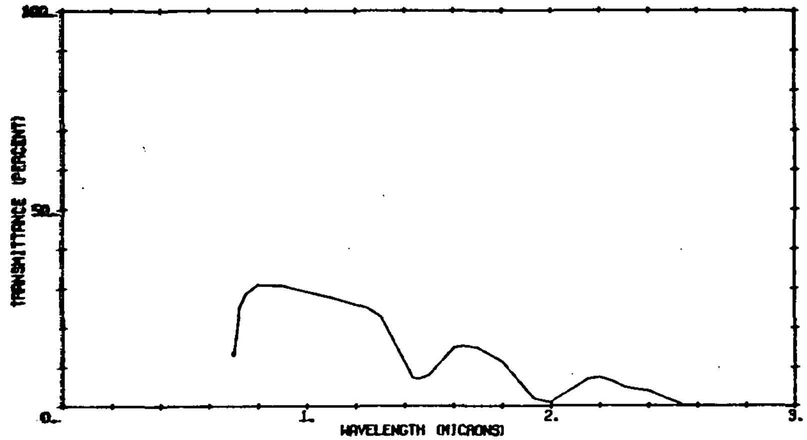
B01948 007

COLEUS, GREEN LEAF.



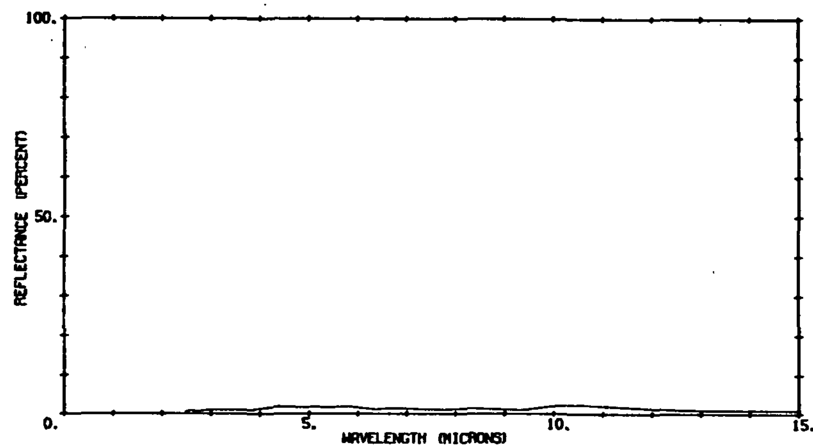
B01948 009

RUBBER PLANT, FICUS ELASTICA, LEAF.



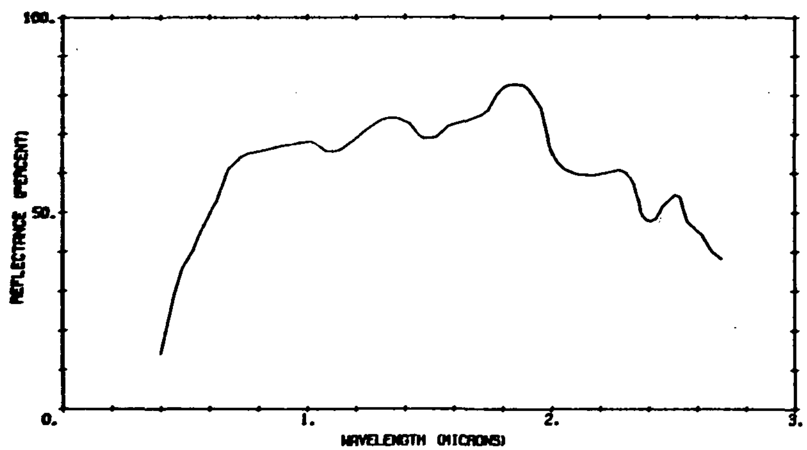
B04696 044

AMERICAN LARCH (LARIX LARICINA), MOSAIC OF NEEDLES.



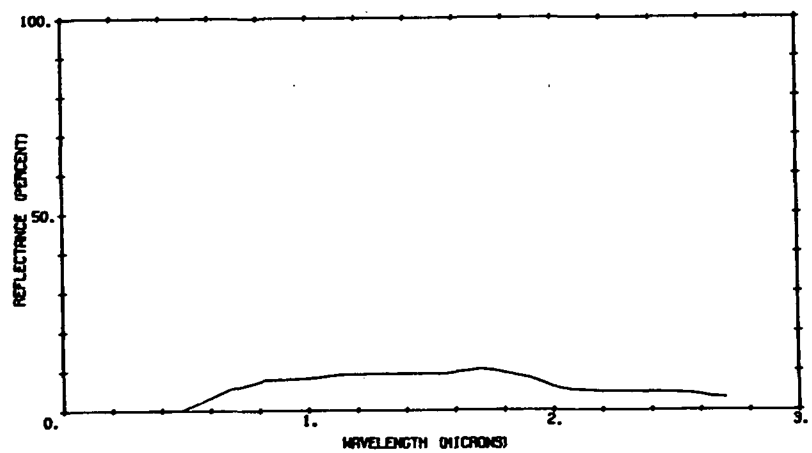
B04803 026

MADRONE LEAVES, NEWLY FALLEN, LOWER LEAF SURFACE.



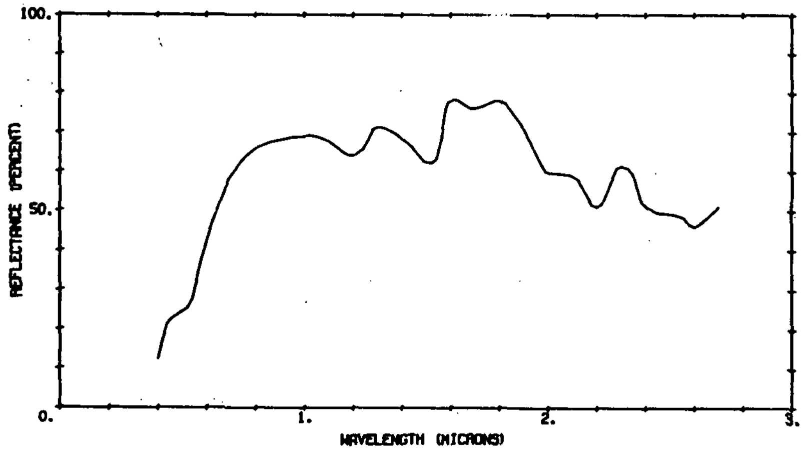
B04803 027

MADRONE LEAVES, NEWLY FALLEN, LOWER LEAF SURFACE.



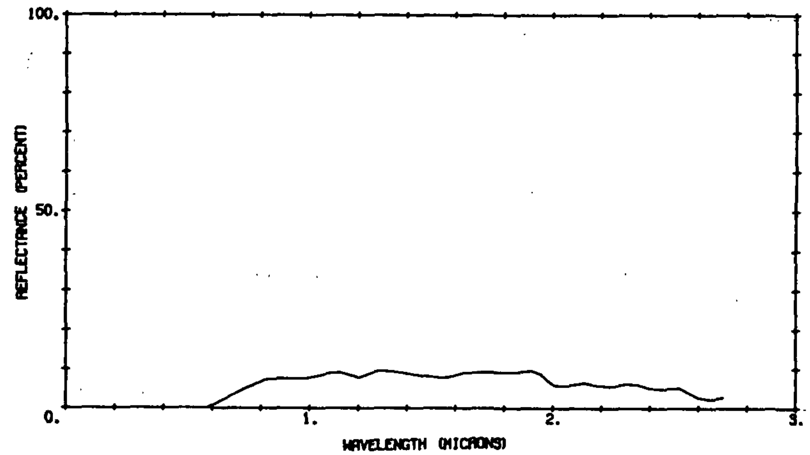
B04803 028

MADRONE LEAVES, NEWLY FALLEN, UPPER LEAF SURFACE.



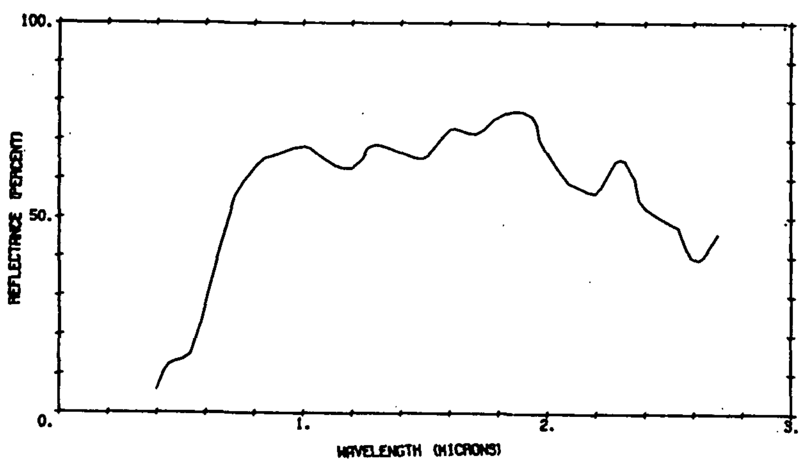
B04803 029

MADRONE LEAVES, NEWLY FALLEN, UPPER LEAF SURFACE.



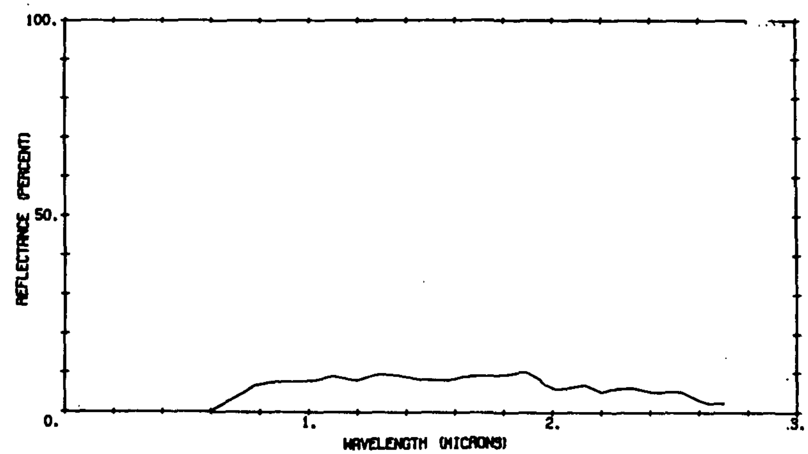
B04803 030

MADRONE LEAVES, NEWLY FALLEN, LOWER LEAF SURFACE.



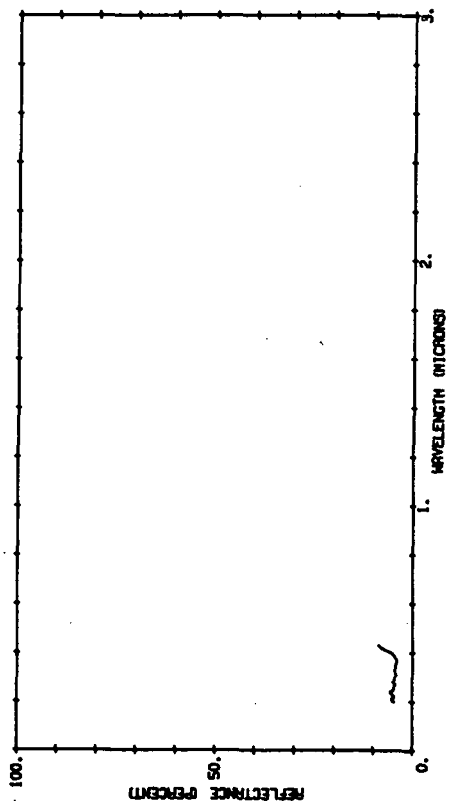
B04803 031

MADRONE LEAVES, NEWLY FALLEN, LOWER LEAF SURFACE.



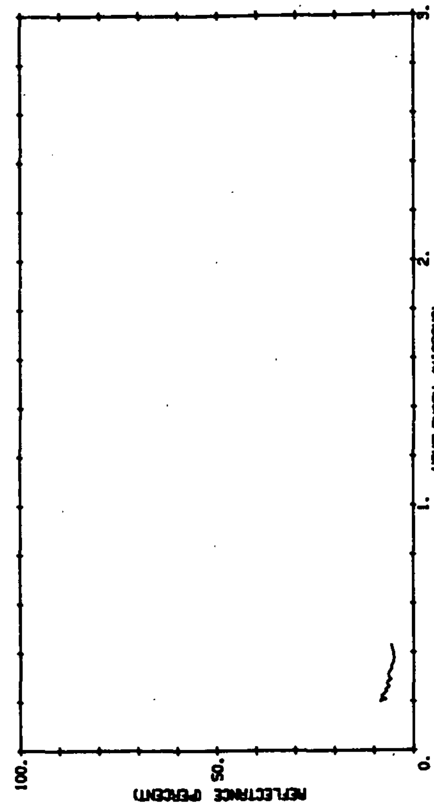
B14004 029

AZALEA LEAF, BOTTOM



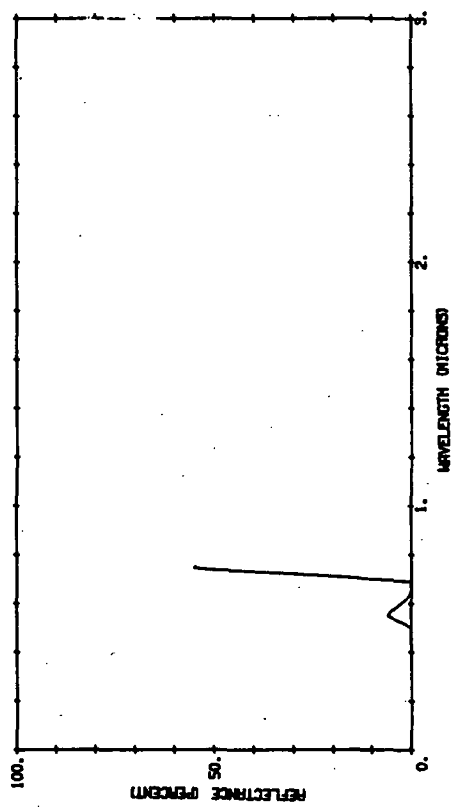
B14004 031

AZALEA LEAF, TOP



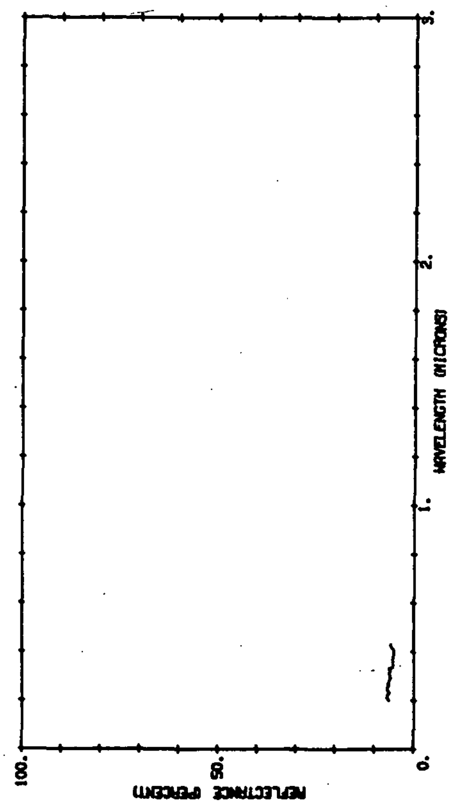
B05272 005

LOCUST LEAVES



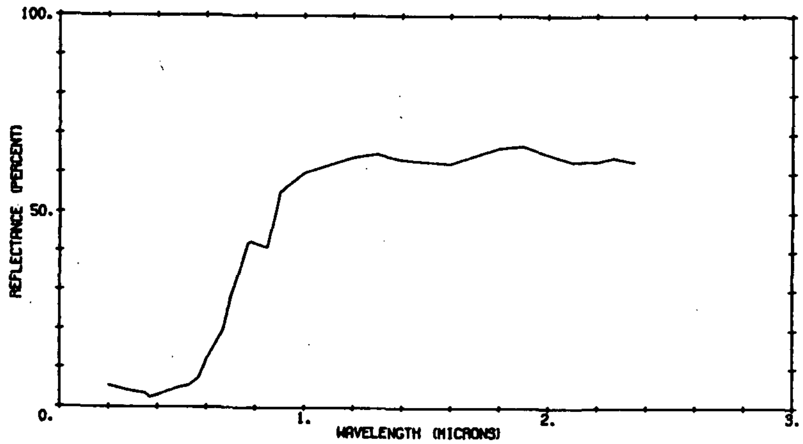
B14004 030

AZALEA LEAF, TOP



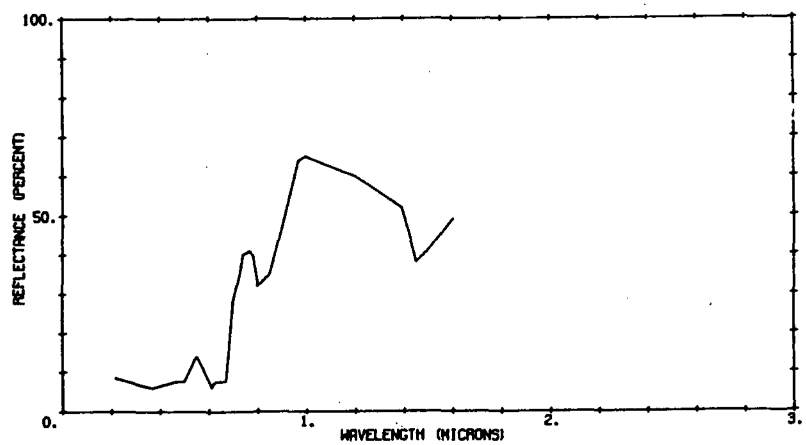
B14004 099

AZALEA, 3 DAYS IN WEATHER AFTER PICKING



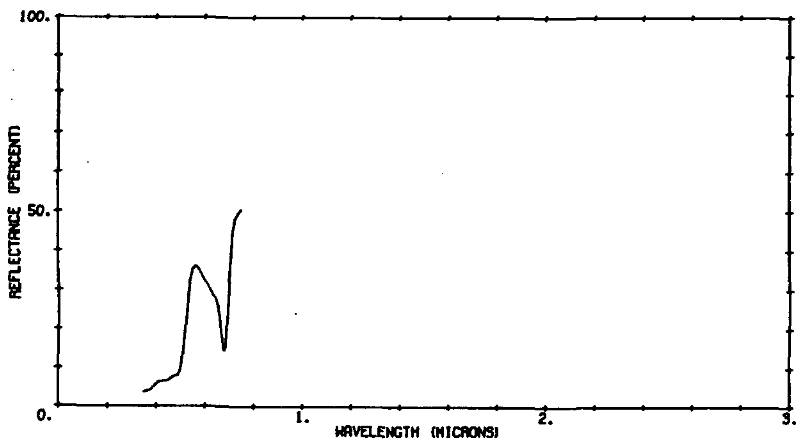
B14004 100

AZALEA, 3-8HRS. IN LAB AFTER PICKING



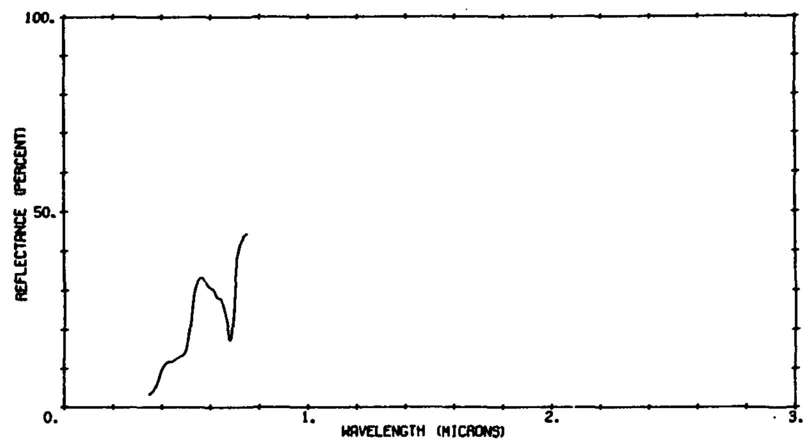
B20000 021

ALBINO COLEUS PLANT, TERMINAL LEAF, UPPER LEAF SURFACE, BEFORE PICKING.



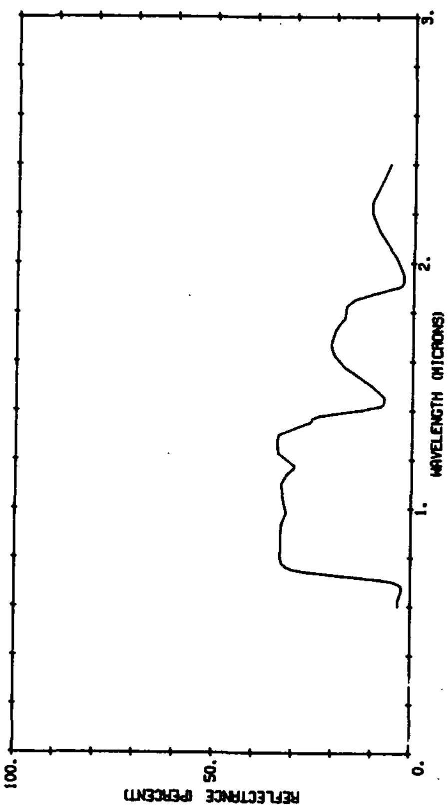
B20000 022

ALBINO COLEUS PLANT, TERMINAL LEAF, LOWER LEAF SURFACE, BEFORE PICKING.



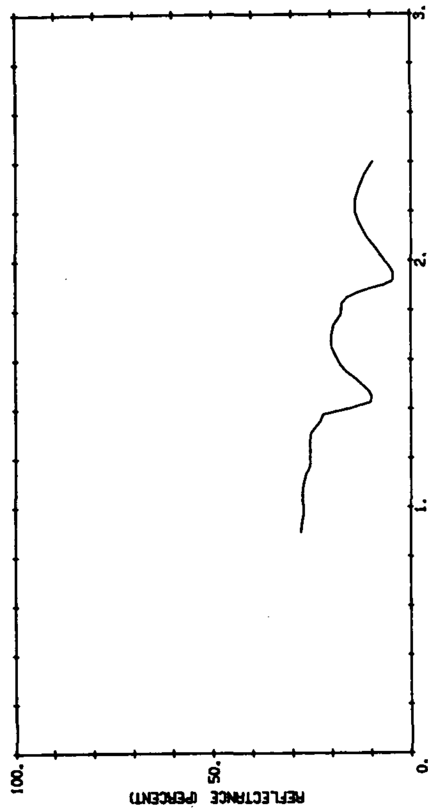
B20000 050

GERANIUM, TERMINAL LEAF, UPPER LEAF SURFACE, BEFORE PICKING.



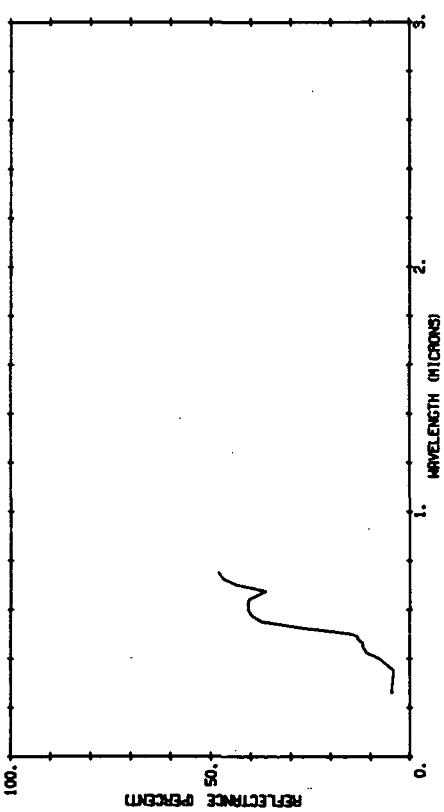
B20000 054

ALBINO COLEUS PLANT, TERMINAL LEAF, LOWER LEAF SURFACE, BEFORE PICKING.



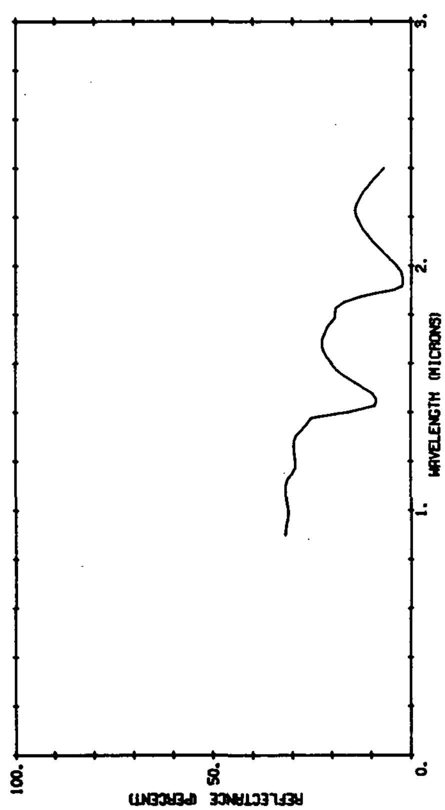
B20000 027

ALBINO COLEUS PLANT, UPPER LEAF SURFACE, 4 HOURS AFTERPICKIN G.



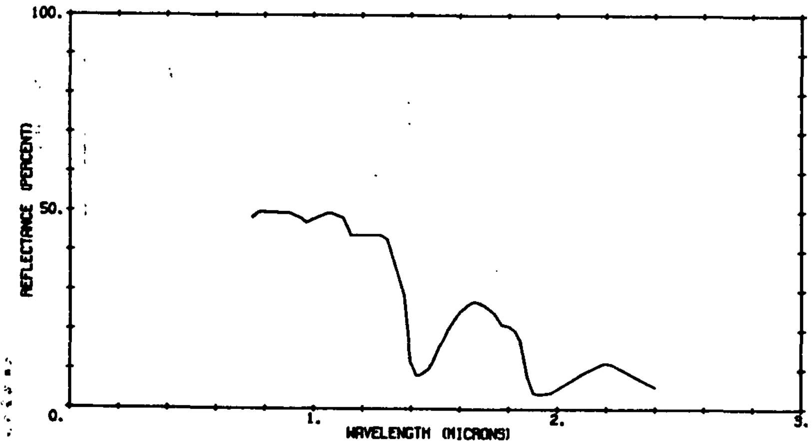
B20000 053

ALBINO COLEUS PLANT, TERMINAL LEAF, UPPER LEAF SURFACE, BEFORE PICKING.



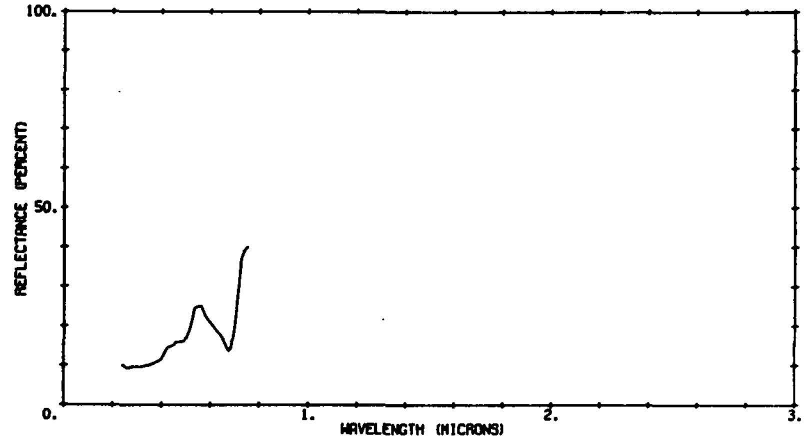
B20000 087

GERANIUM, UPPER LEAF SURFACE, 5 MINUTES AFTER PICKING.



B20000 233

PARARUBBER, FICUS ELASTICA, LOWER LEAF SURFACE, BEFORE PICKI
NG.



B20000 258

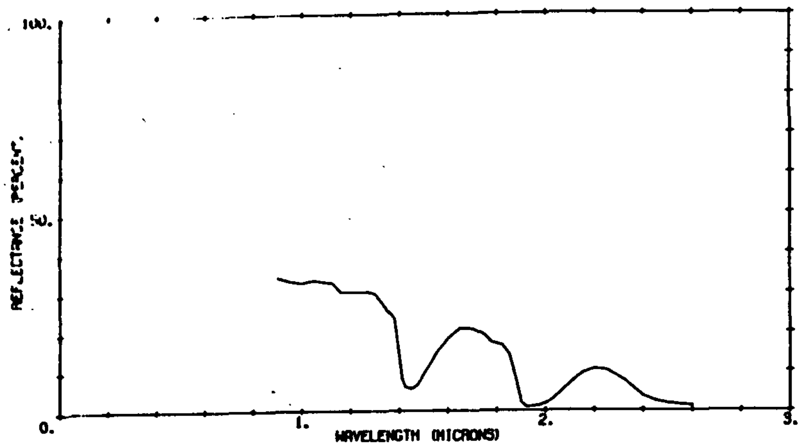
GERANIUM LEAF, LOWER LEAF SURFACE.

B20000 257

GERANIUM LEAF, UPPER LEAF SURFACE.

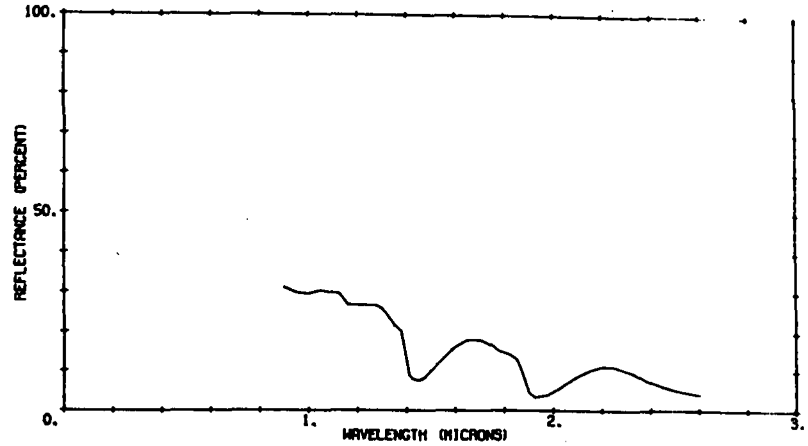
B20000 259

DARK RED COLEUS, TERMINAL LEAF, UPPER LEAF SURFACE.



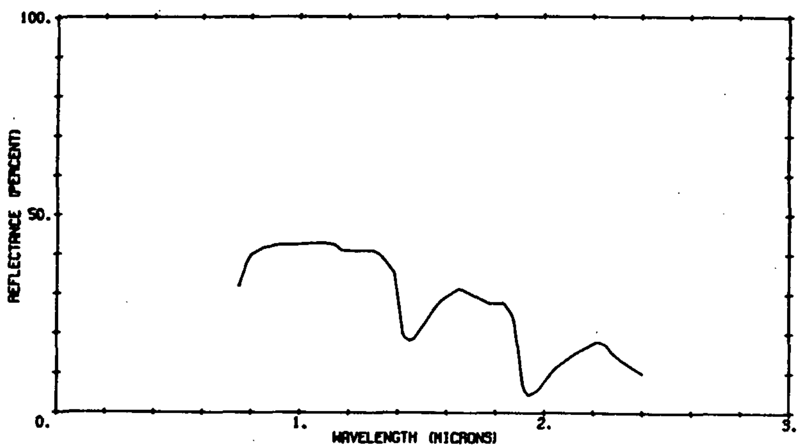
B20000 260

DARK RED COLEUS, TERMINAL LEAF, LOWER LEAF SURFACE.



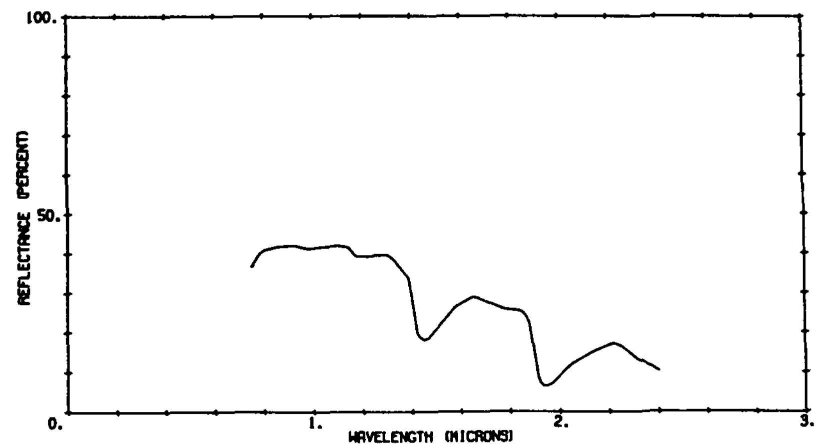
B20000 313

ELM, UPPER LEAF SURFACE, AFTER 48 HOURS EXPOSURE TO OUTSIDE WEATHER.



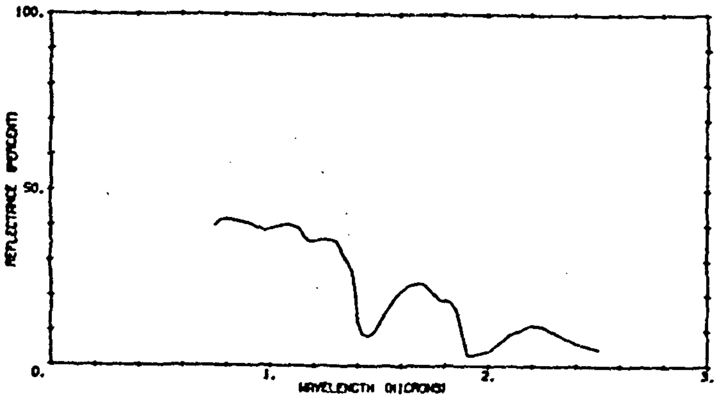
B20000 314

ELM, LOWER LEAF SURFACE, AFTER 48 HOURS EXPOSURE TO OUTSIDE WEATHER.



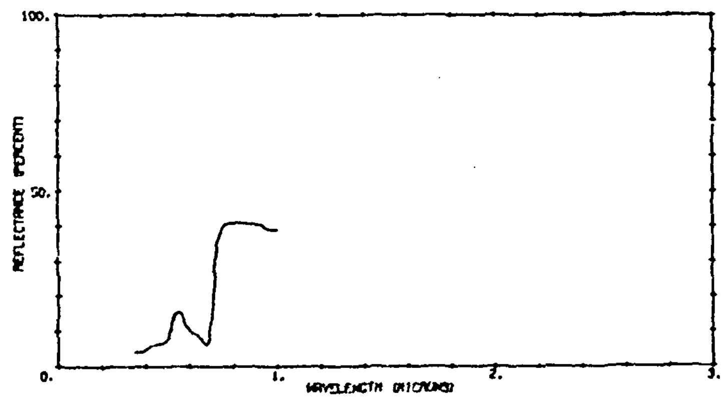
B20000 343

PHILODENDRON, LOWER LEAF SURFACE, BEFORE PICKING.



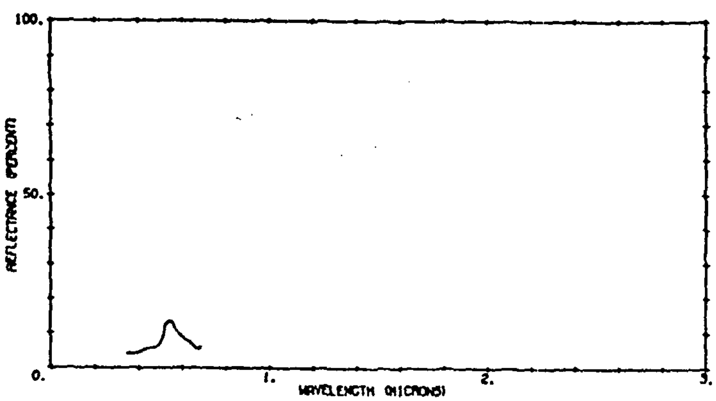
B20000 351

COCOANUT PALM, UPPER LEAF SURFACE, ABOUT 3[illegible] MINUTES AFTER PICKING.



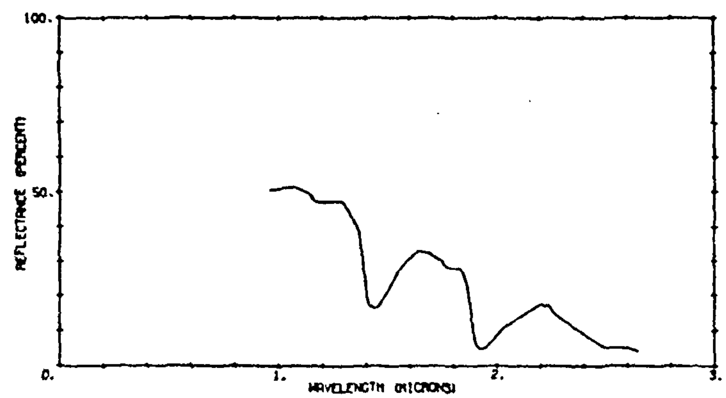
B20000 352

COCOANUT PALM, LOWER LEAF SURFACE, ABOUT 33 MINUTES AFTER PICKING.



B20000 353

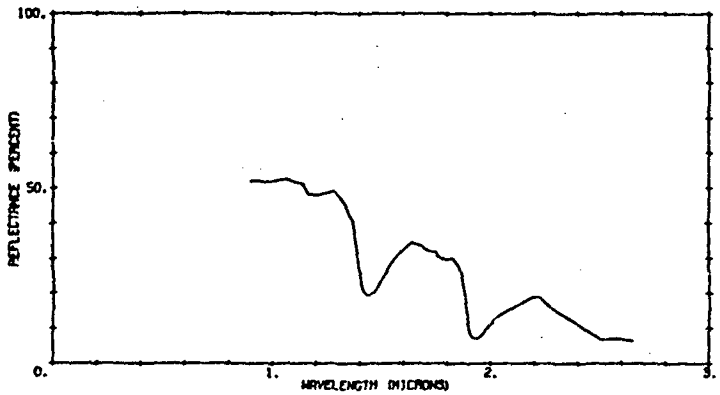
COCOANUT PALM, UPPER LEAF SURFACE, ABOUT 3[illegible] MINUTES AFTER PICKING.



324

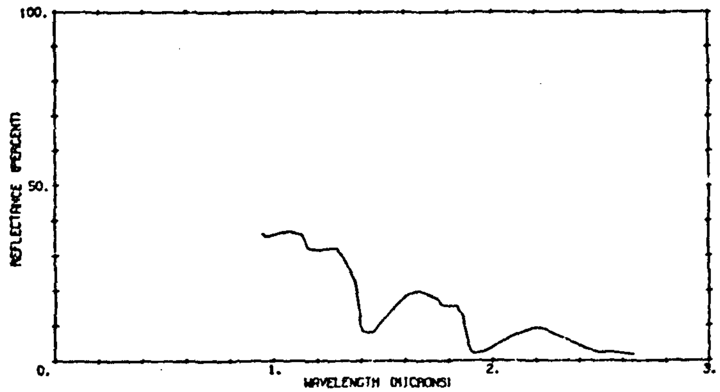
B20000 354

COCOANUT PALM, LOWER LEAF SURFACE, ABOUT 35 MINUTES AFTER PICKING.



B20000 355

PALMETTO PALM (WASHINGTONIA R.), UPPER LEAF SURFACE, ABOUT 30 MINUTES AFTER PICKING.



BGD 24

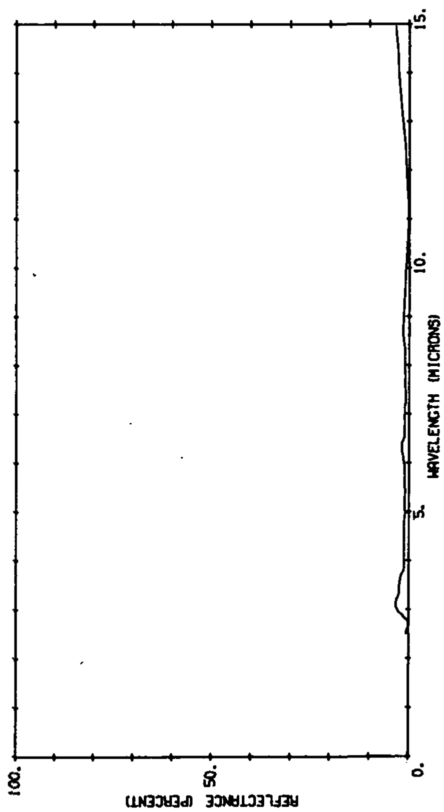
325

BH
WATER

326

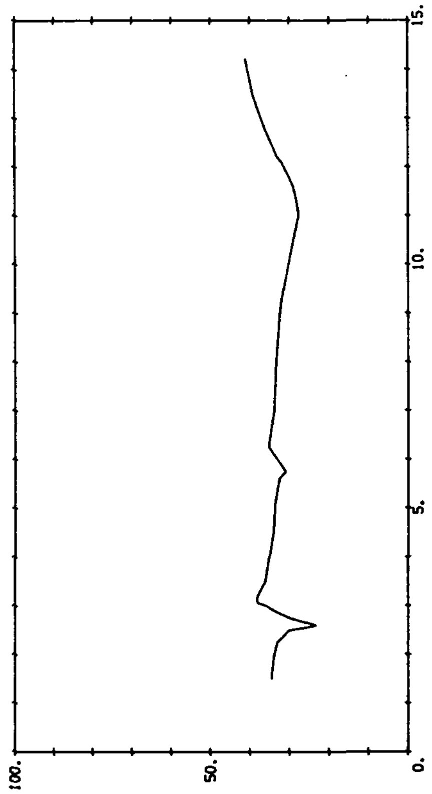
B03333 017

TAP WATER, .25 INCHES DEEP ON STEEL



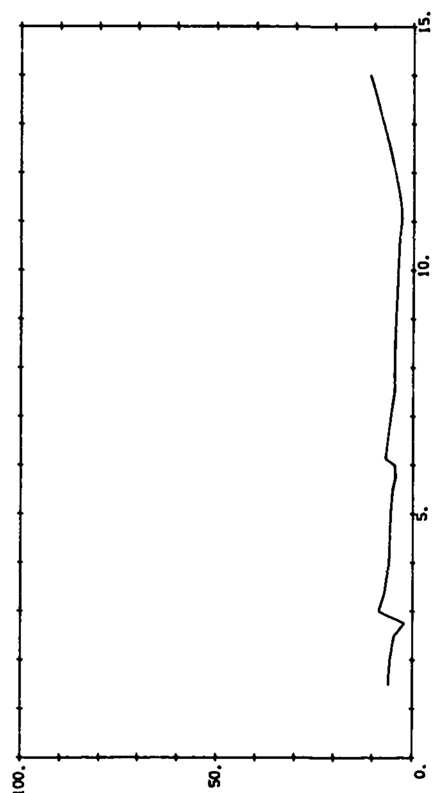
B03355 007

REFLECTION FROM WATER SURFACE, DEGREE ANGLE OF INCIDENCE



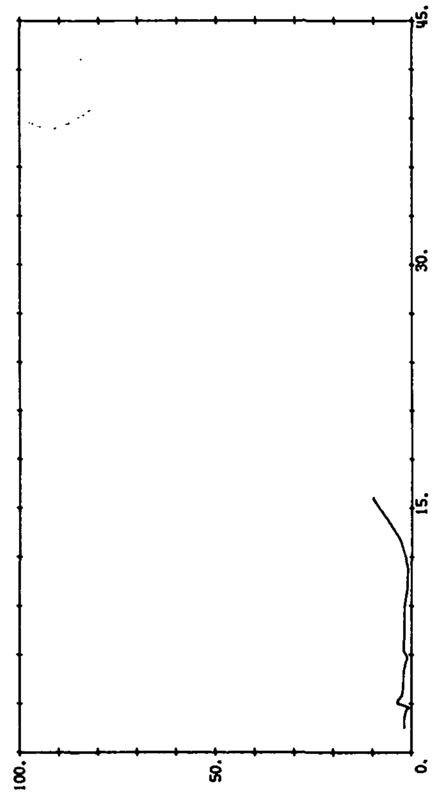
B03355 008

REFLECTION FROM WATER SURFACE, DEGREE ANGLE OF INCIDENCE



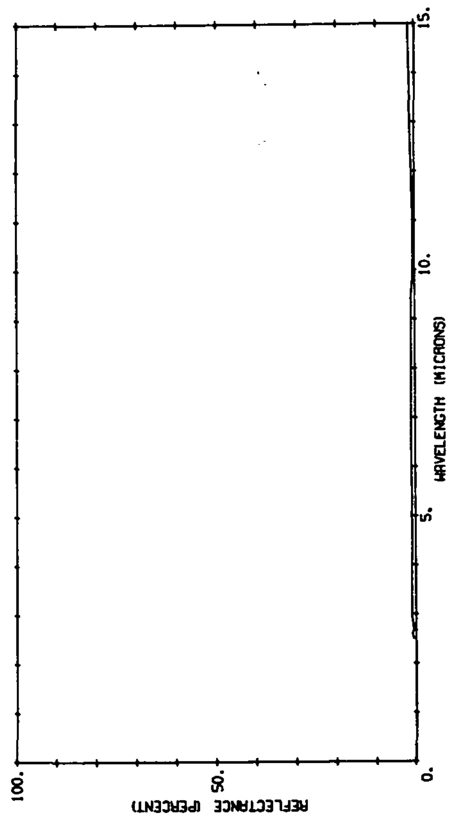
B03355 009

REFLECTION FROM WATER SURFACE, DEGREE ANGLE OF INCIDENCE



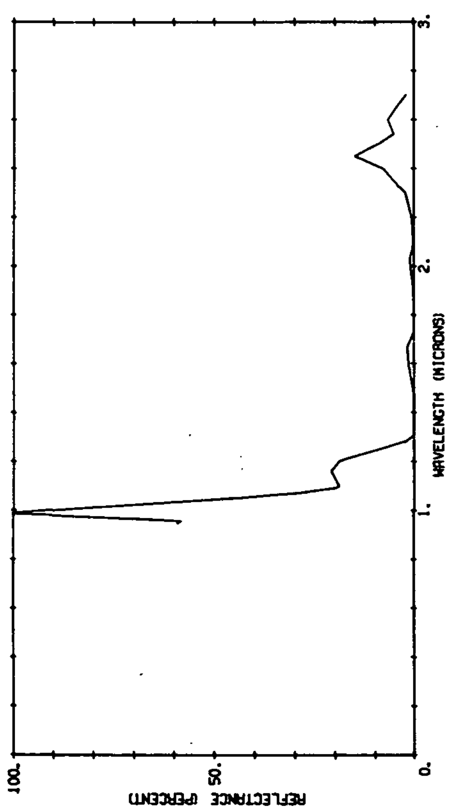
B04696 046

WATER.



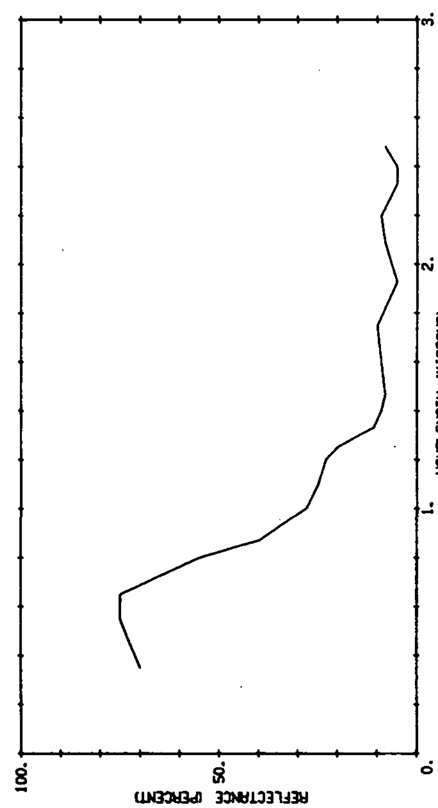
B04424 001

SNOW, MOIST



B13946 031

SNOW, OLD.



4.2.2. FIELD DATA

Data contained in this Section were obtained from the following documents:

Airborne Measurements-B01035
B01370

Ground Measurements-B01337
B01643

Ground and Airborne Measurements-B03258
B03995

329

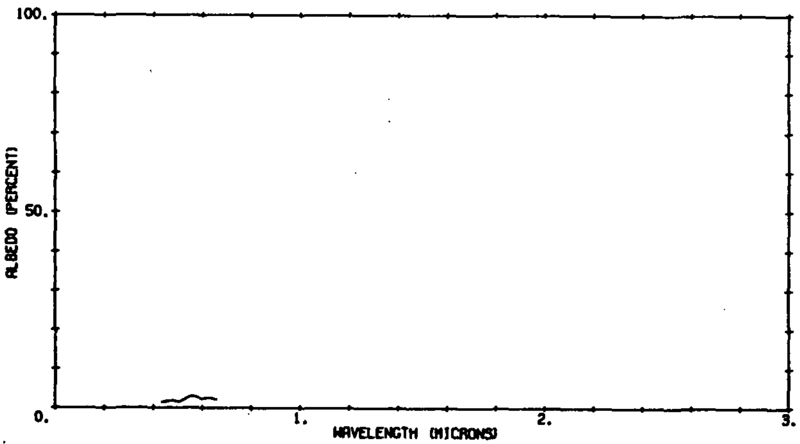
(F)BE

TERRAIN UNIFORMITY

330

B01370 003

FIELD, DARK GREEN (YUMA ARIZONA)

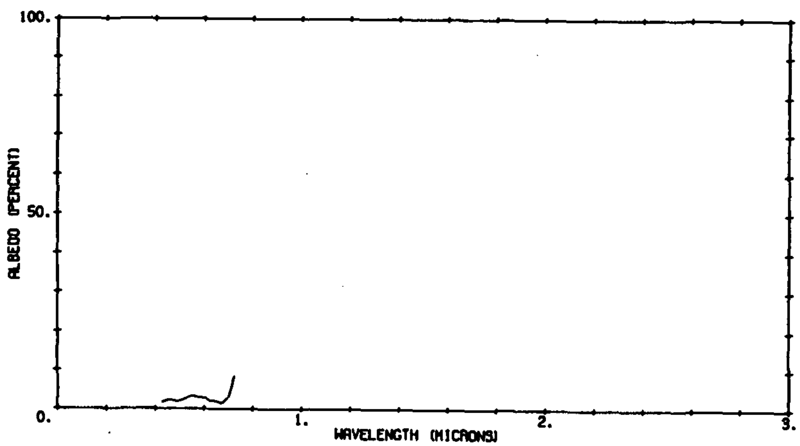


B01370 004

FIELD, BROWN (ORLANDO, FLORIDA)

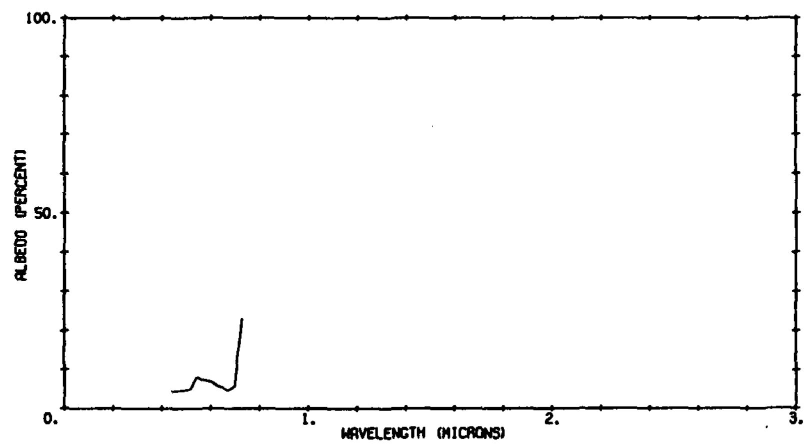
B01370 009

FIELD, GREEN WITH SOME BROWN SHOWING (ORLANDO, FLORIDA)



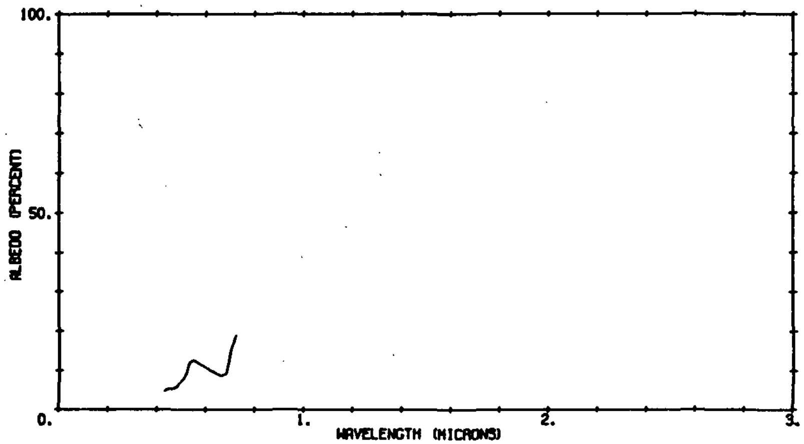
B01370 013

FIELD, GREEN (ORLANDO, FLORIDA)



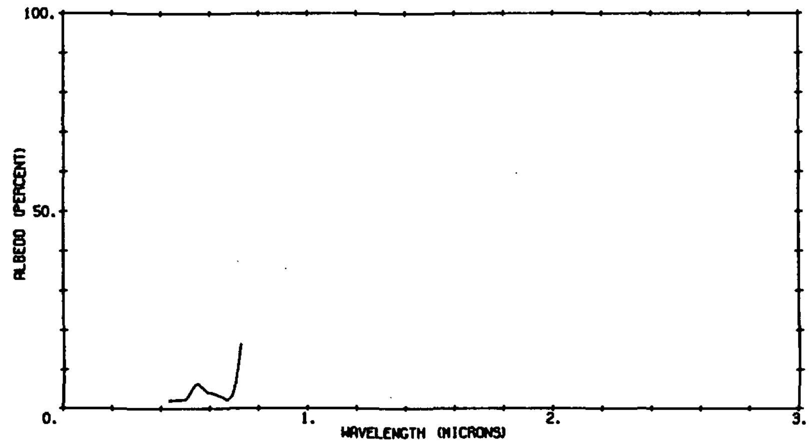
B01370 015

LIGHT YELLOWISH GREEN AREA (ORLANDO, FLORIDA)



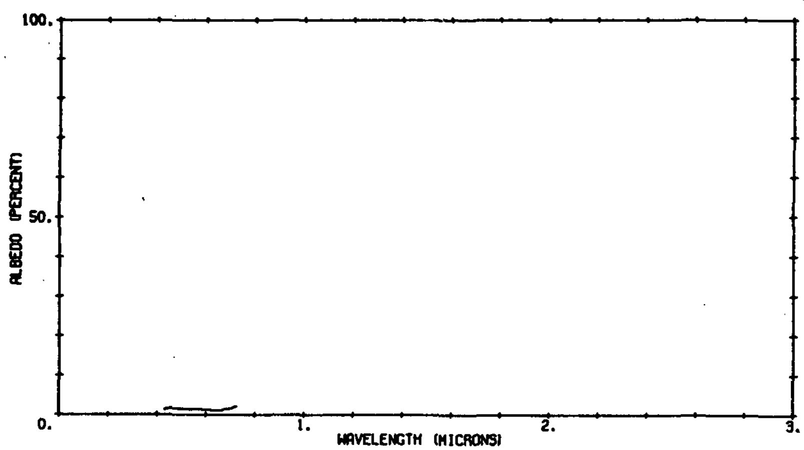
B01370 016

DARK GREEN AREA (ORLANDO, FLORIDA)



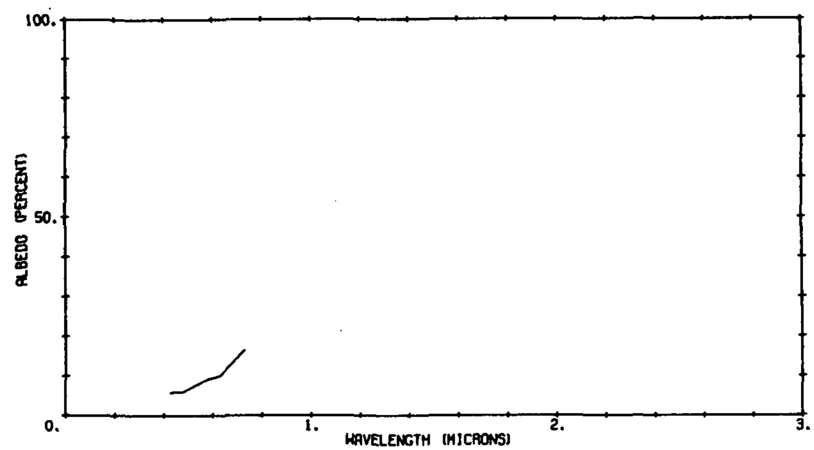
B01370 018

BROWN EARTH IN SHADOW OF TREE (ORLANDO, FLORIDA)



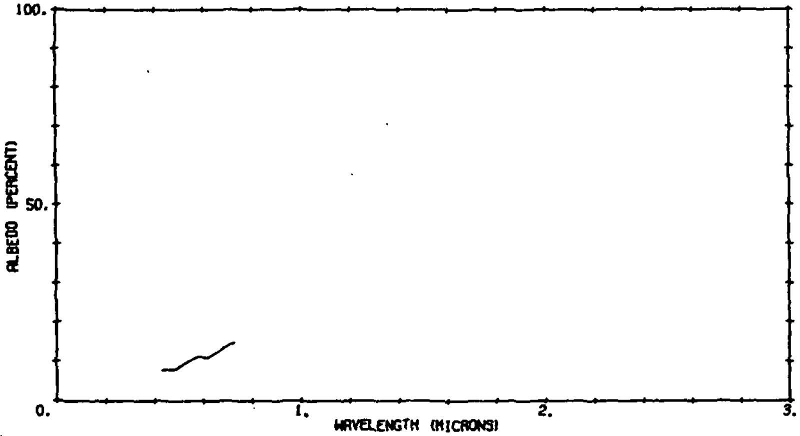
B01370 021

GROUND, LITTLE VEGETATION (ORLANDO, FLORIDA)



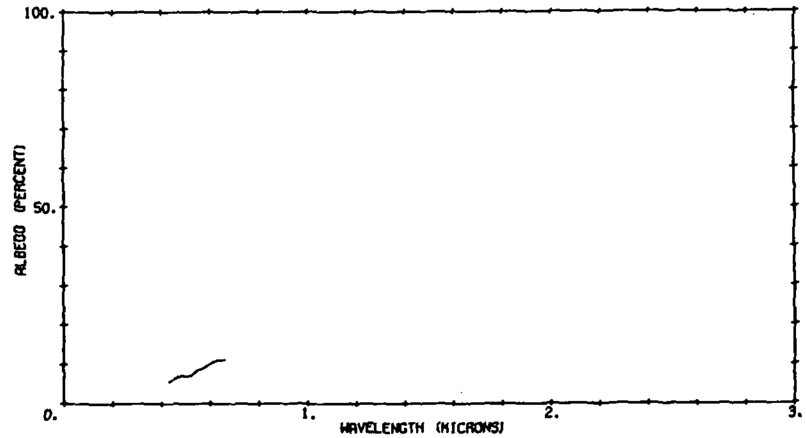
B01370 022

SANDY GROUND (ORLANDO, FLORIDA)



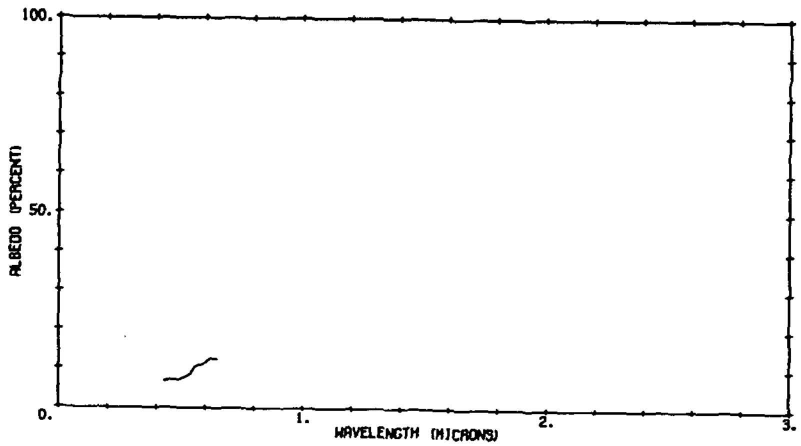
B01370 027

RED HILLS (DESERT CENTER, CALIF.)



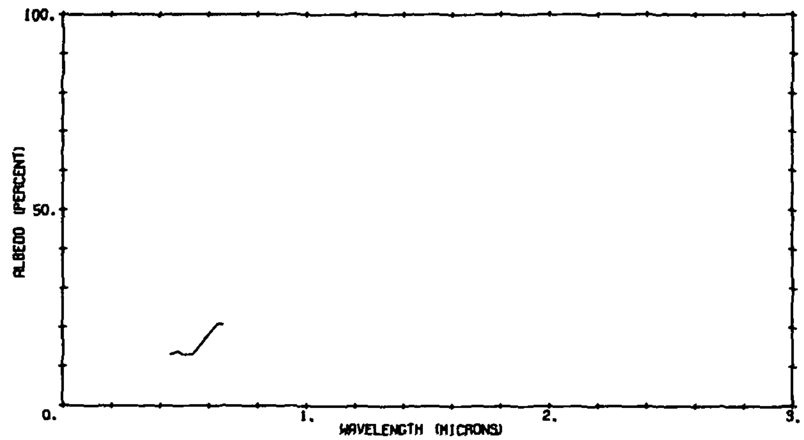
B01370 028

YELLOW SAND, DRY WASH (THERMAL, CALIF.)



B01370 029

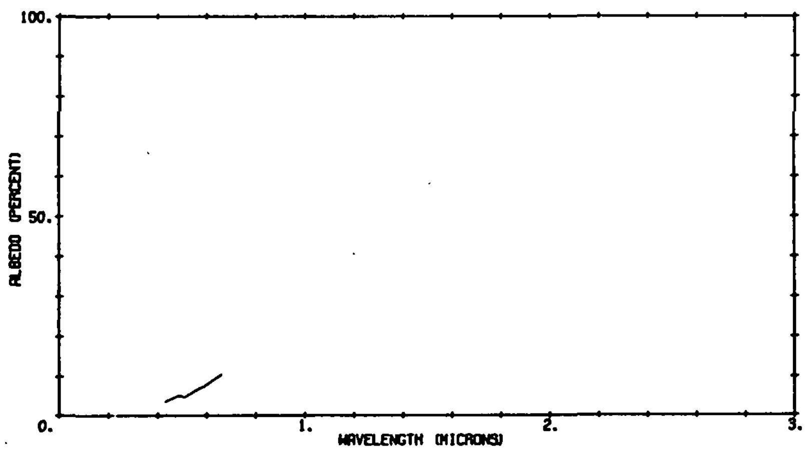
DRY WASH, TAN AREA (DESERT CENTER, CALIF.)



(F)BE 3

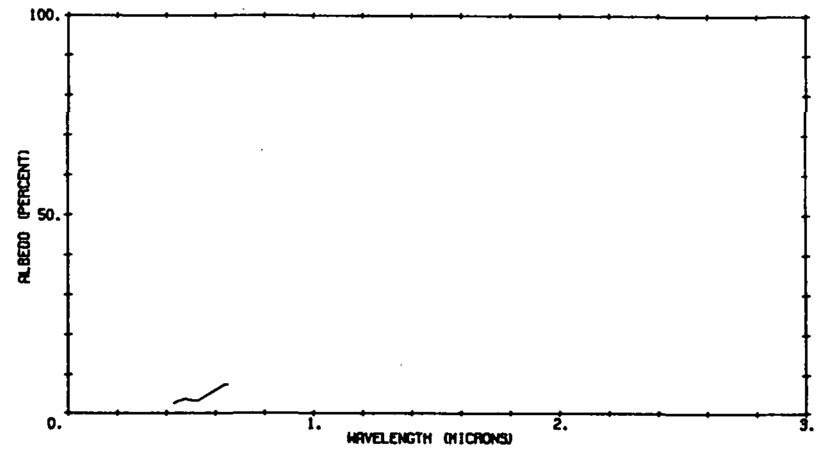
B01370 030

RED MOUNTAINS, LIGHT RED GROUND (MOJAVE DESERT, CALIF.)



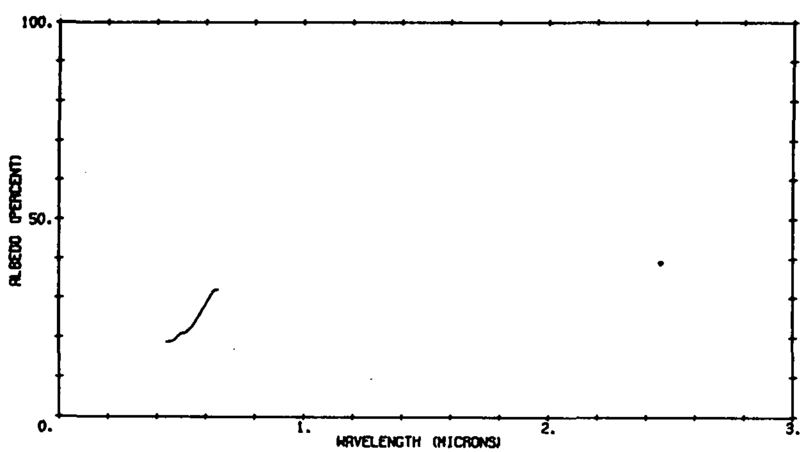
B01370 031

RED MOUNTAINS, LIGHT RED GROUND (MOJAVE DESERT, CALIF.)



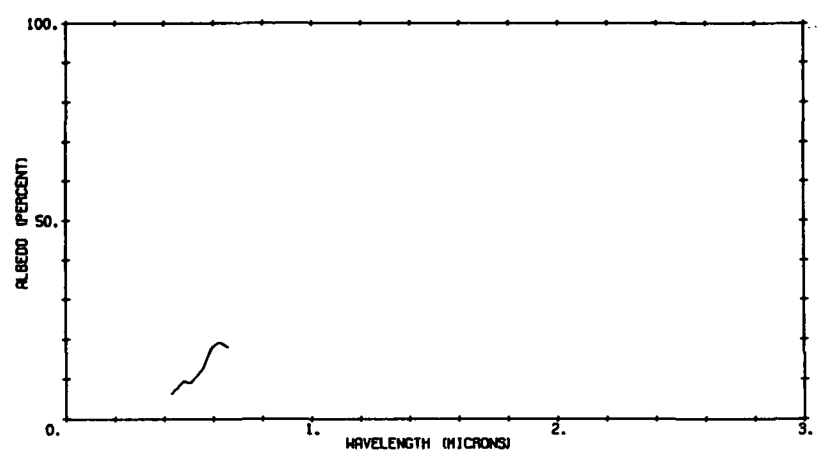
B01370 032

YELLOW SAND, DRY WASH (DESERT CENTER, CALIF.)



B01370 033

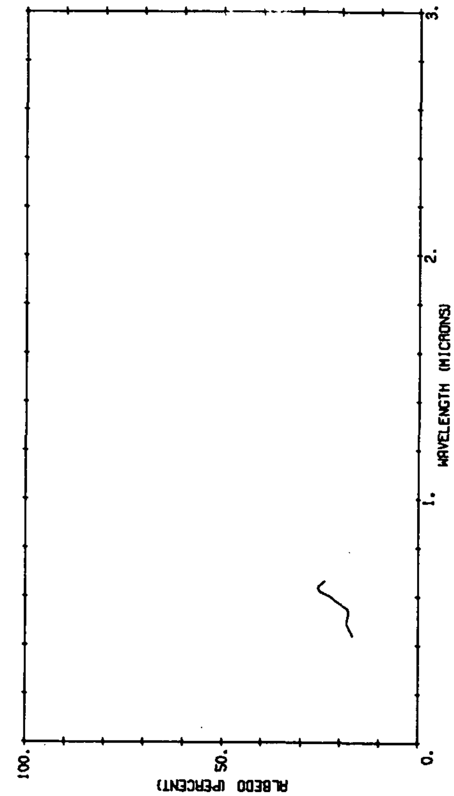
SAND DUNES, SHADOW ON YELLOW SAND (MOJAVE DESERT, CALIF.)



(F)BE 4

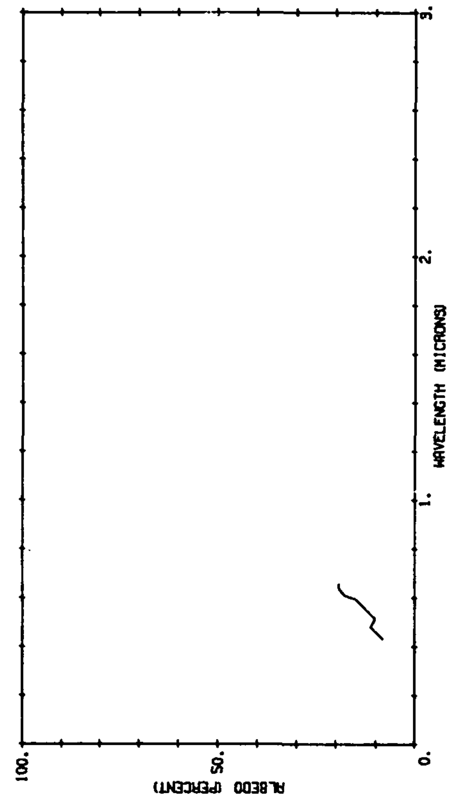
B01370 035

LIGHT TAN, AREA IN WHITE FLATS (DESERT CENTER, CALIF.)



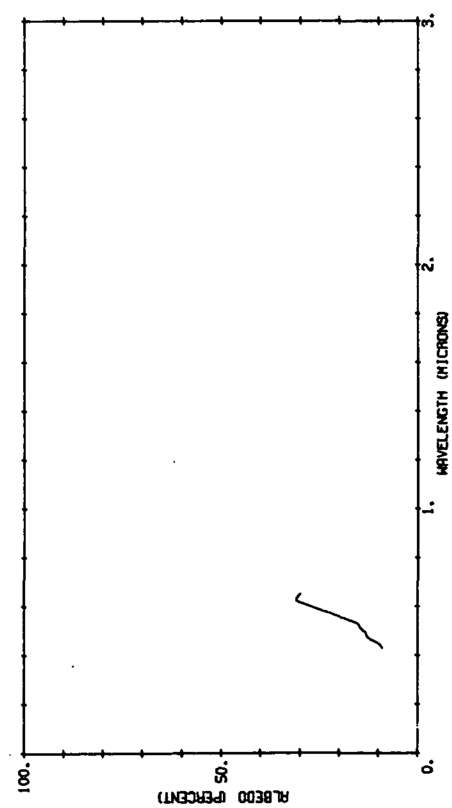
B01370 037

ROCKS AND SAND, RED MOUNTAINS (DESERT CENTER, CALIF.)



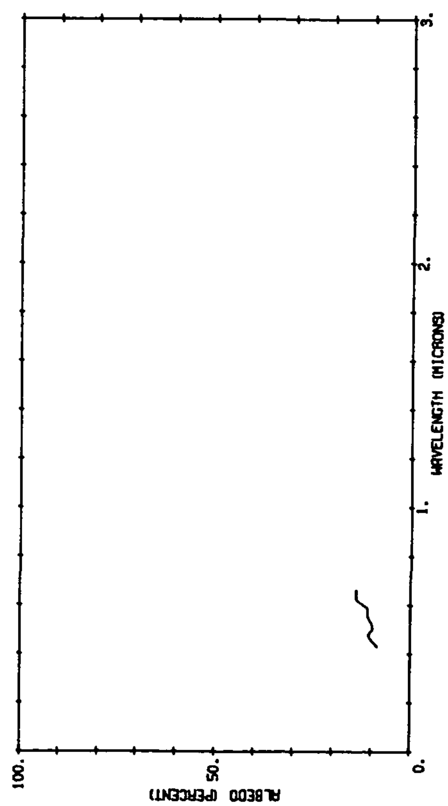
B01370 034

SAND DUNES, YELLOW SAND (MOJAVE DESERT, CALIF.)



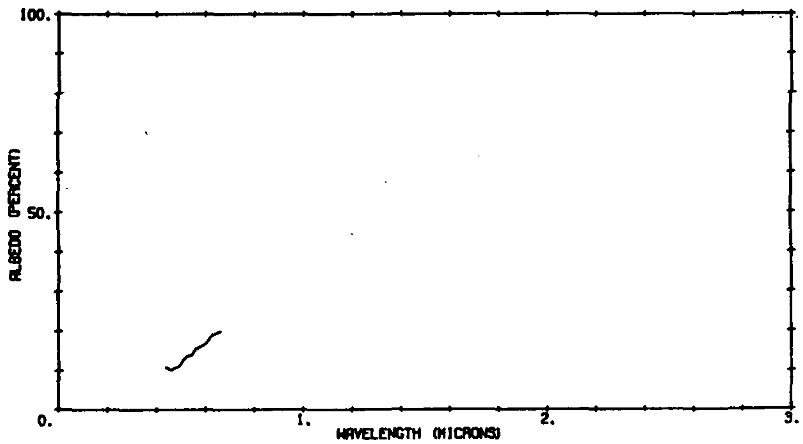
B01370 036

DRY WASH, DARK BROWN SAND (DESERT CENTER, CALIF.)



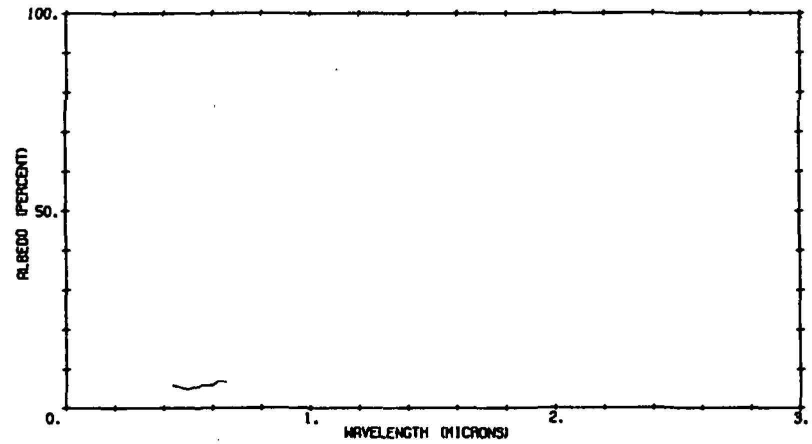
B01370 038

LIGHT SAND, SLOPE OF VOLCANO (DESERT CENTER, CALIF.)



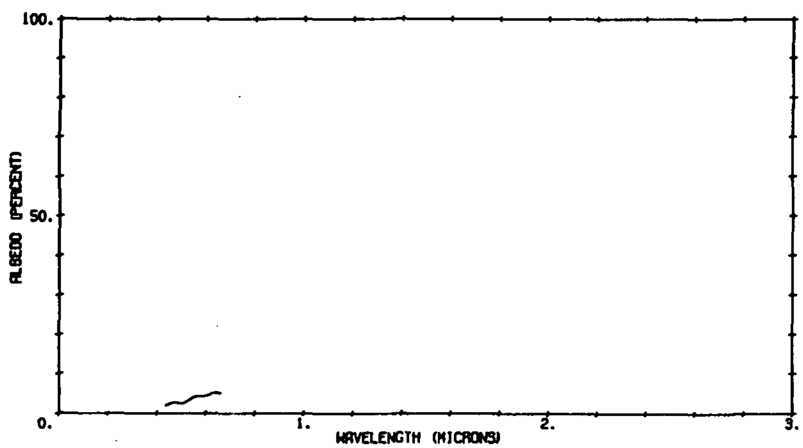
B01370 039

DARK VOLCANIC ROCK, SLOPE OF VOLCANO (DESERT CENTER, CALIF.)



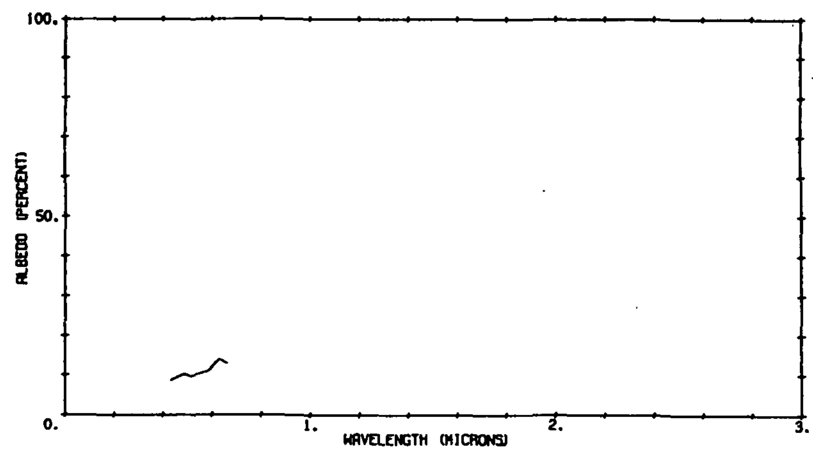
B01370 040

LOW RED HILLS, DARK RED (DESERT CENTER, CALIF.)



B01370 041

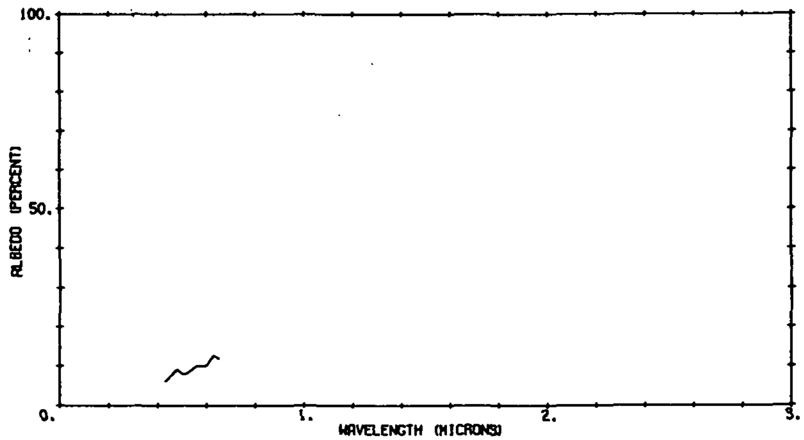
DRY WASH (DESERT CENTER, CALIF.)



(F)BE 6

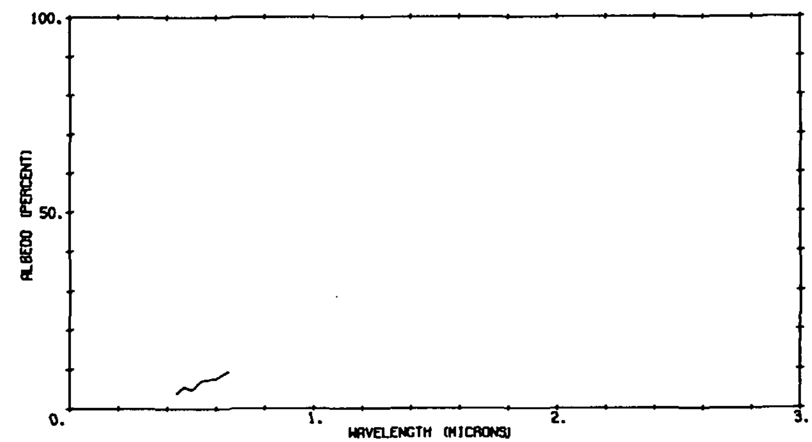
B01370 042

RED MOUNTAINS, LIGHT RED-BROWN AREA (DESERT CENTER, CALIF.)



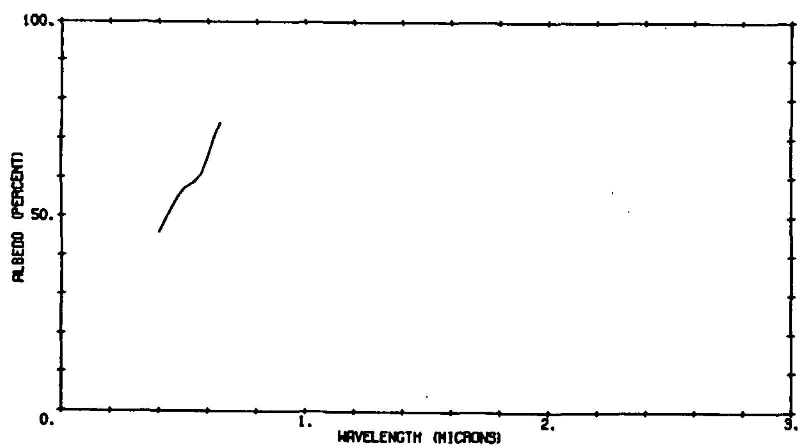
B01370 043

RED HILLS, GREEN-BROWN AREA (DESERT CENTER, CALIF.)



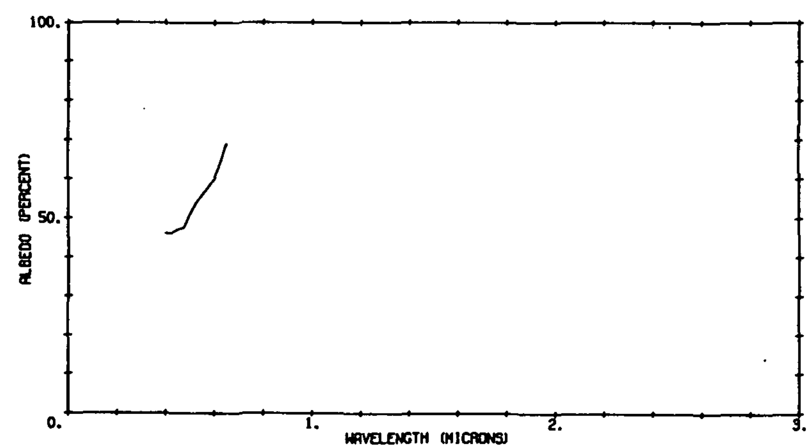
B03258 001

SALT BED



B03258 002

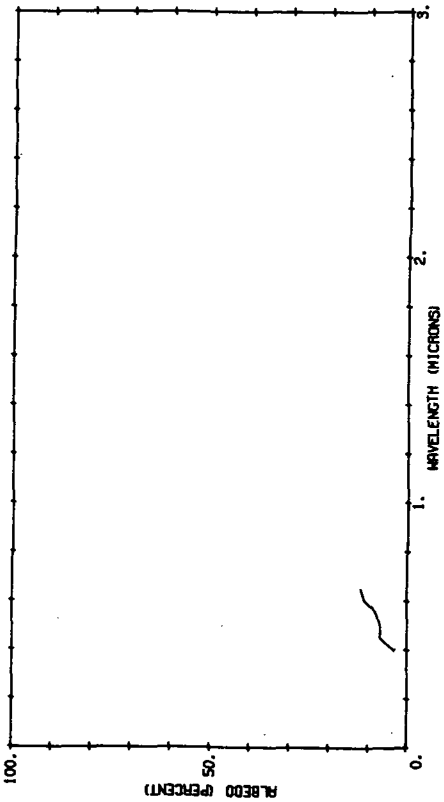
NON-SALINE PLAYA



(F)BE 7

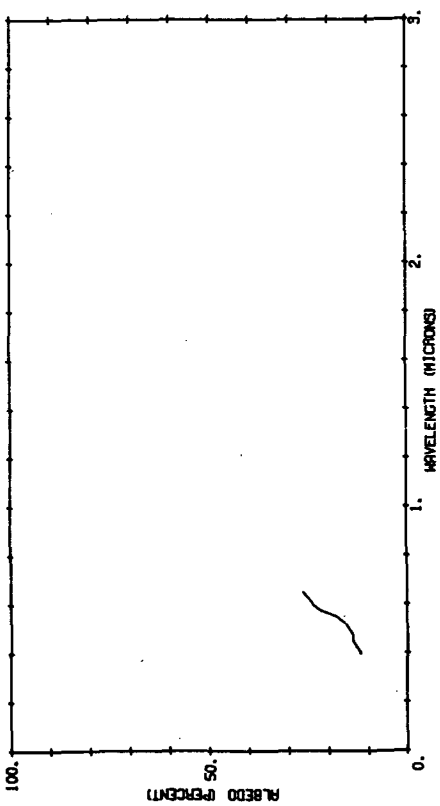
B03258 007

LAG SURFACE OF REU SCORIA ON SAND



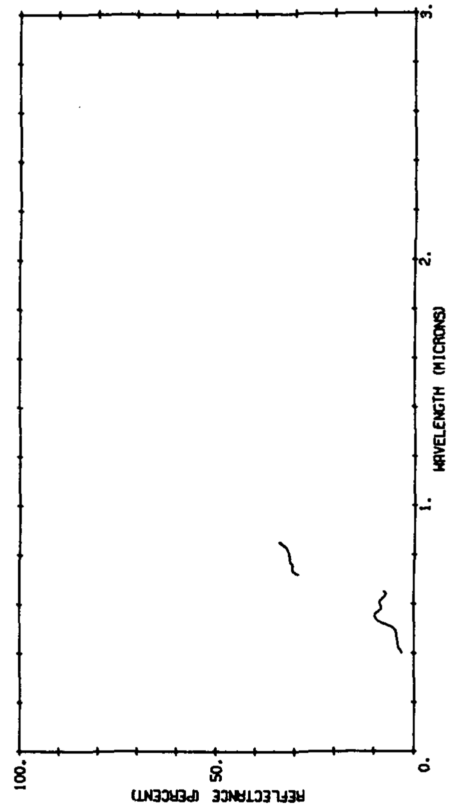
B03258 003

BRUSH AND WINDBLOWN SAND



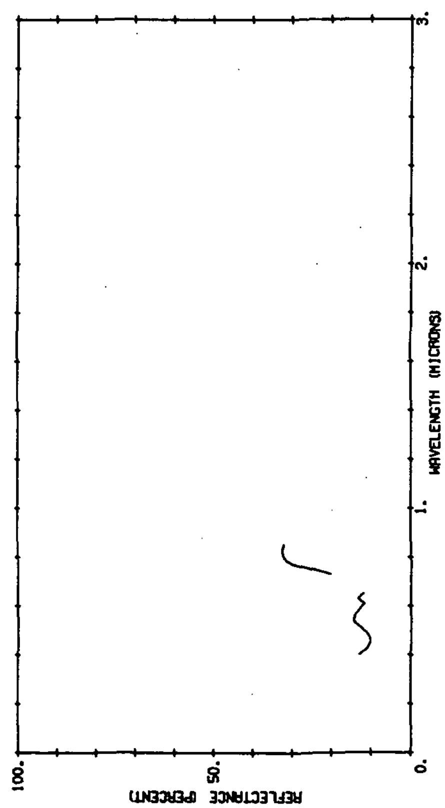
B03995 075

PASTURE MEADOW, AT END OF SUMMER, NORMAL



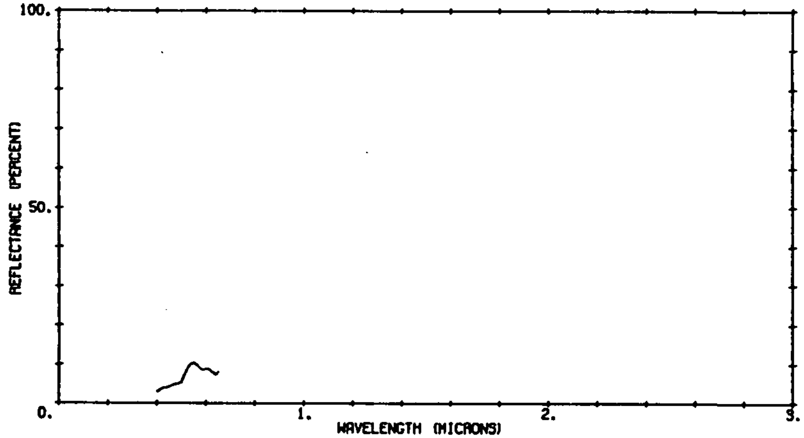
R03995 054

RIVER VALLEY WITH MEADOWS, END OF SUMMER, 44.9 DEGREES



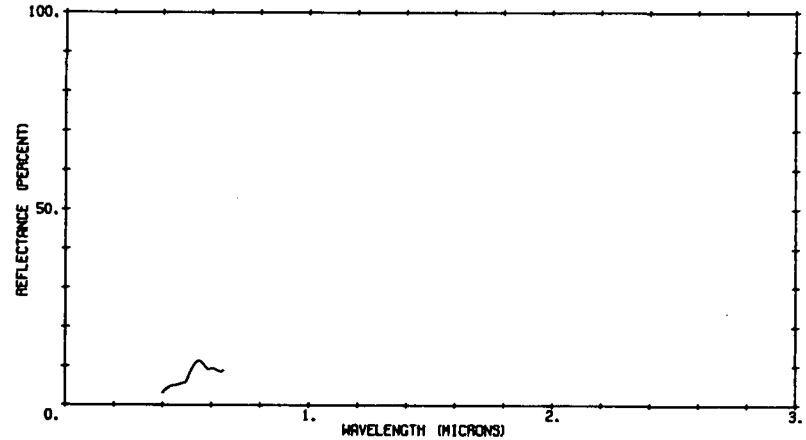
B03995 076

PASTURE MEADOW, AT END OF SUMMER, A=90 DEGREES, ANG.=45 DEGR
EES



B03995 077

PASTURE MEADOW, AT END OF SUMMER, A=180 DEGREES,ANG.=45 DEGR
EES

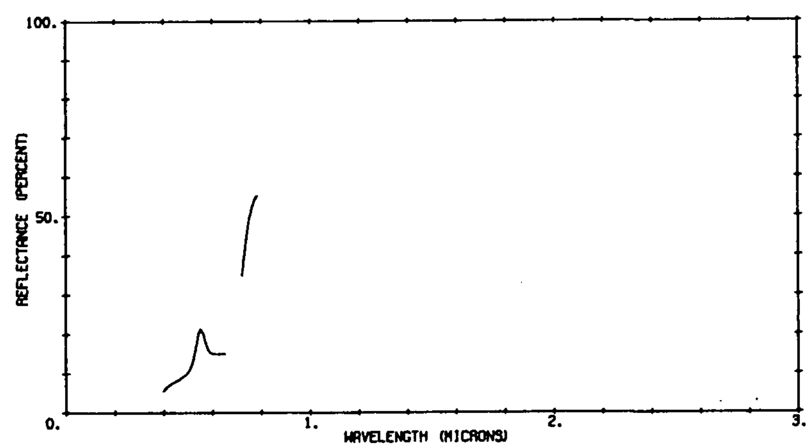


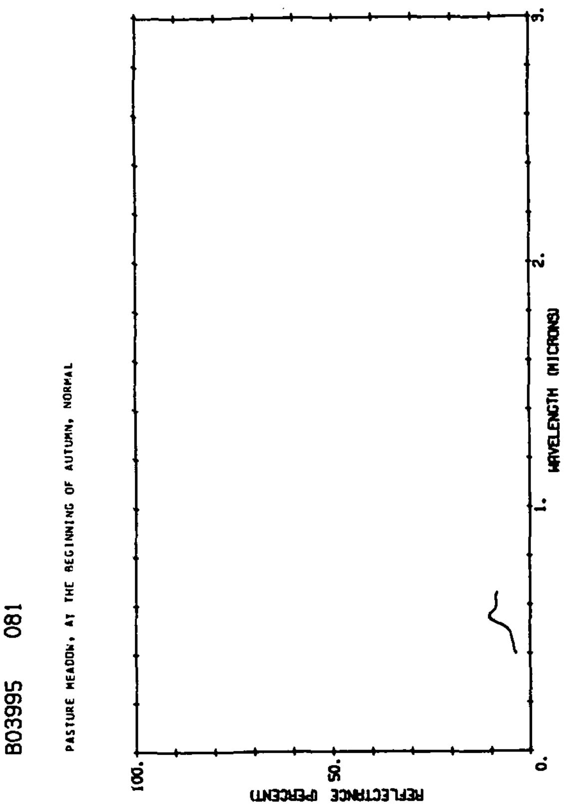
B03995 078

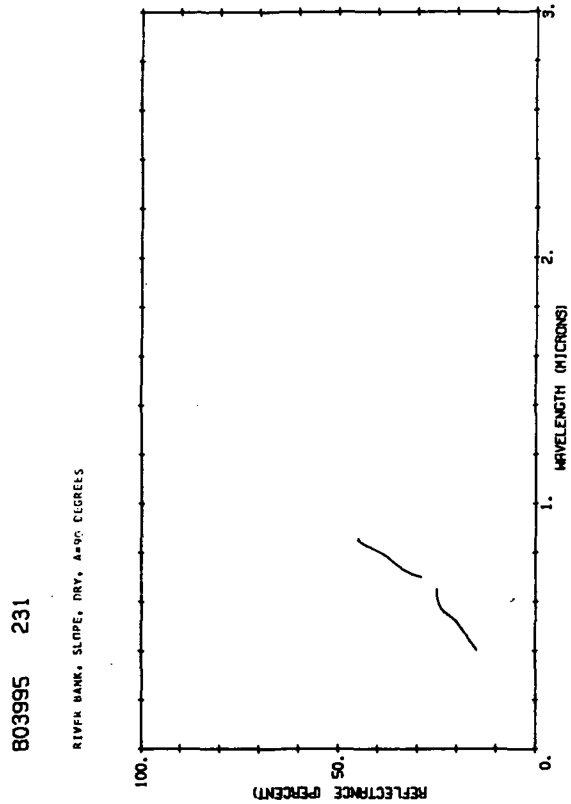
PASTURE MEADOW, AT END OF SUMMER, WET AFTER RAIN, CLOUDY SKY
NORMAL

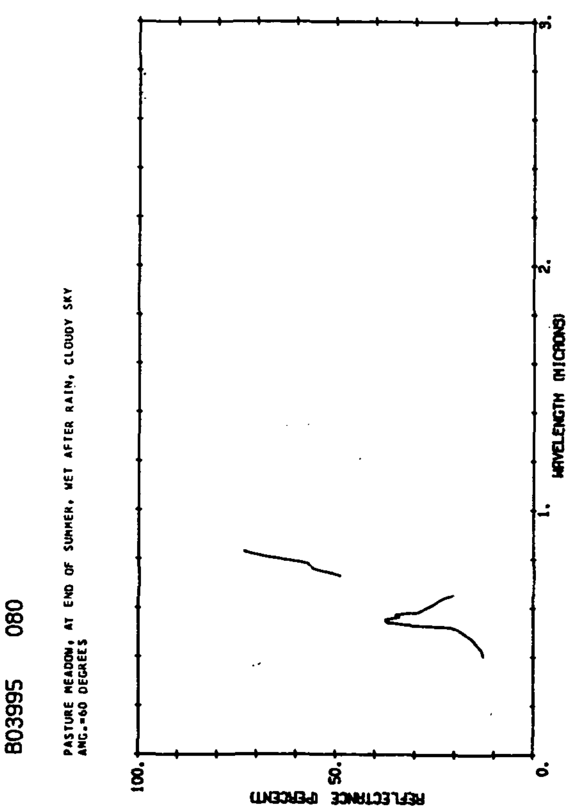
B03995 079

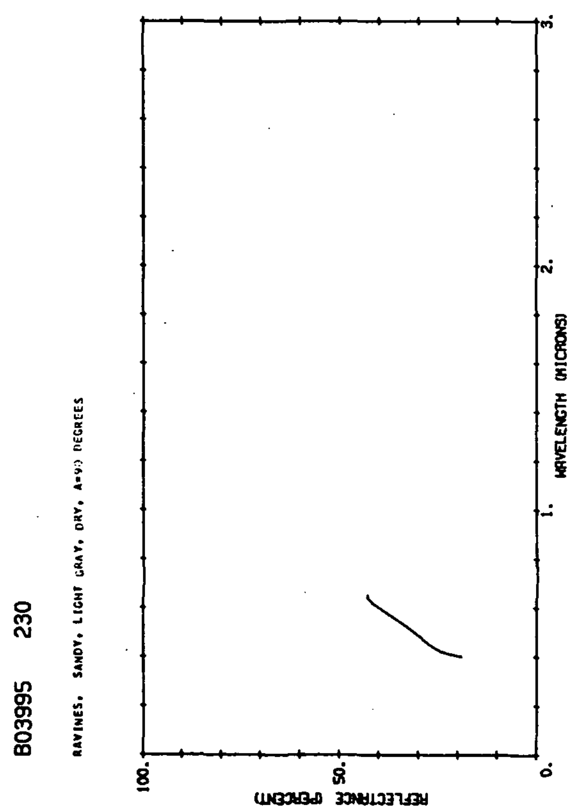
PASTURE MEADOW, AT END OF SUMMER, WET AFTER RAIN, CLOUDY SKY
ANG.=30 DEGREES




B03995 081
PASTURE MEADOW, AT THE BEGINNING OF AUTUMN, NORMAL
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

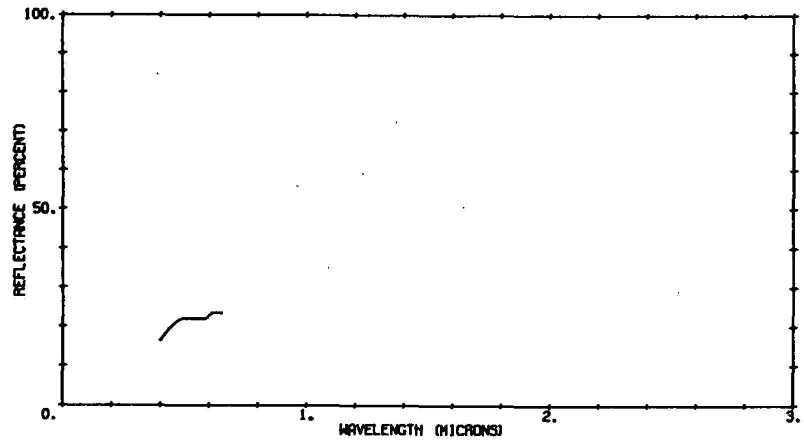

B03995 231
RIVER BANK, SLOPE, DRY, A=90 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B03995 080
PASTURE MEADOW, AT END OF SUMMER, WET AFTER RAIN, CLOUDY SKY
ANG.=60 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B03995 230
RAVINES, SANDY, LIGHT GRAY, DRY, A=90 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

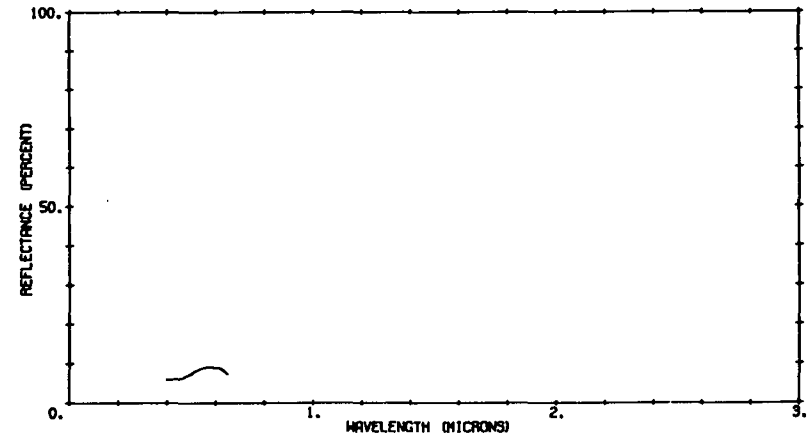
B03995 232

BOULDERS, IN CANYON OF MOUNTAIN STREAM, DRY, NORMAL



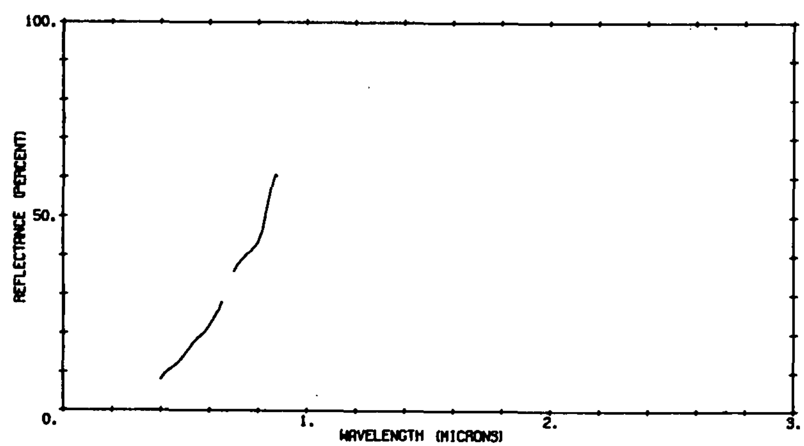
B03995 233

BOULDERS, IN CANYON OF MOUNTAIN STREAM, WET, NORMAL



B03995 235

BOTTOM OF RESERVOIR, SANDY, MOIST, NORMAL DESERT

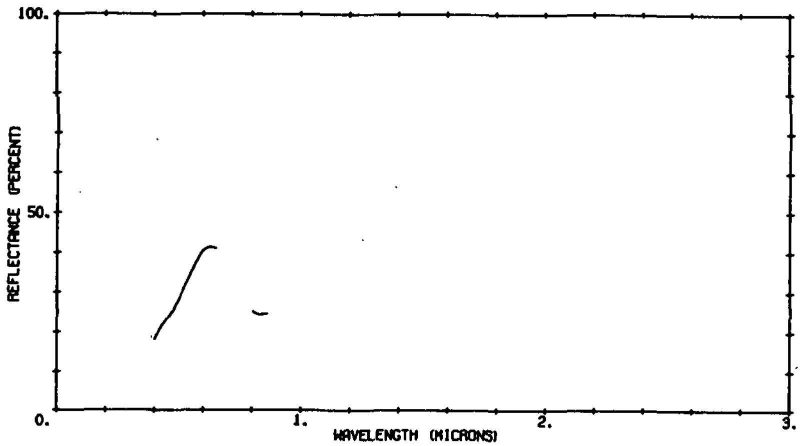


B03995 236

LIMESTONE, DRY, SINGLE SAMPLE, A=90 DEGREES, ANG.=45 DEGREES

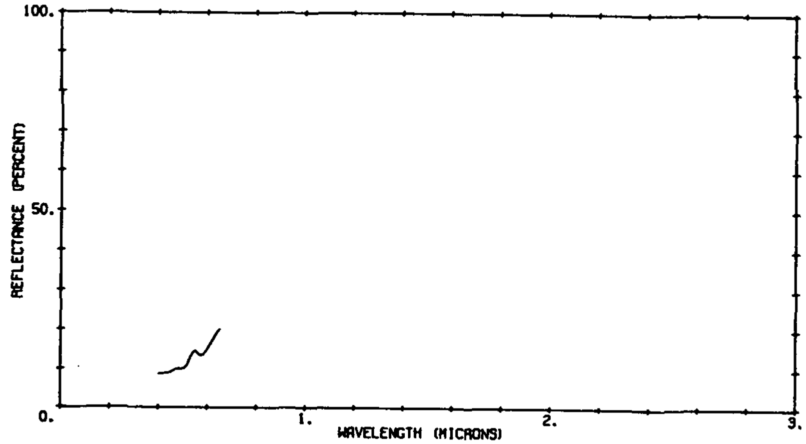
B03995 270

IRIDESCENCE IN PLACES OF WIND EROSION, WHITISH, NORMAL, DESERT



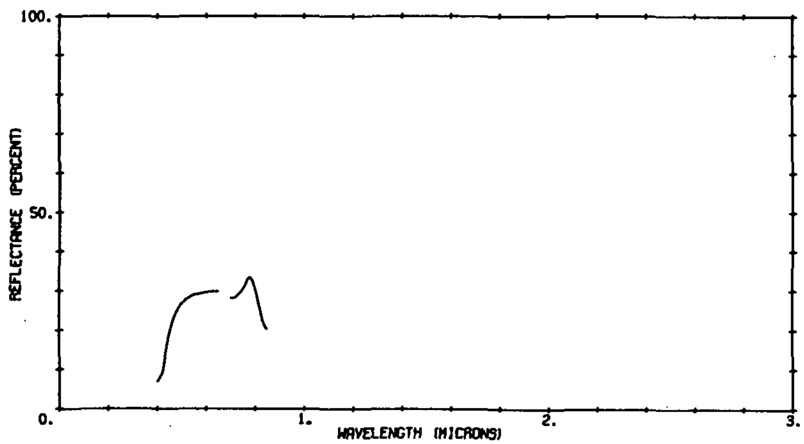
B03995 312

CLIFFS, BARE, DRY, A-11° DEGREES, MOUNTAINOUS



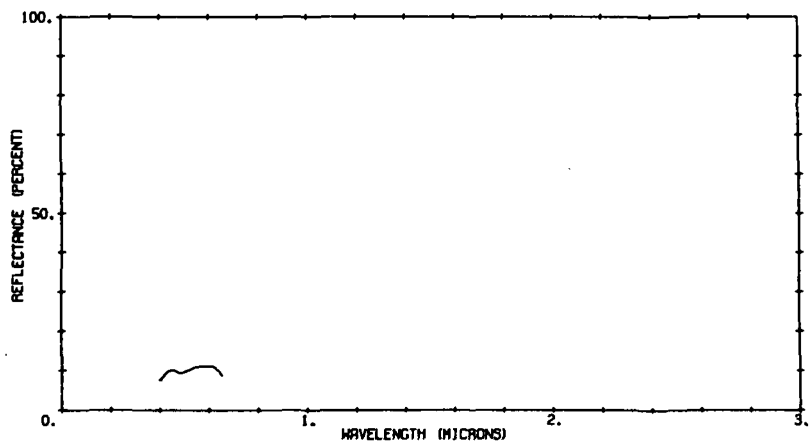
B03995 313

CLIFFS, BARE, DRY, ON MOUNTAIN TOPS, NORMAL MOUNTAINOUS



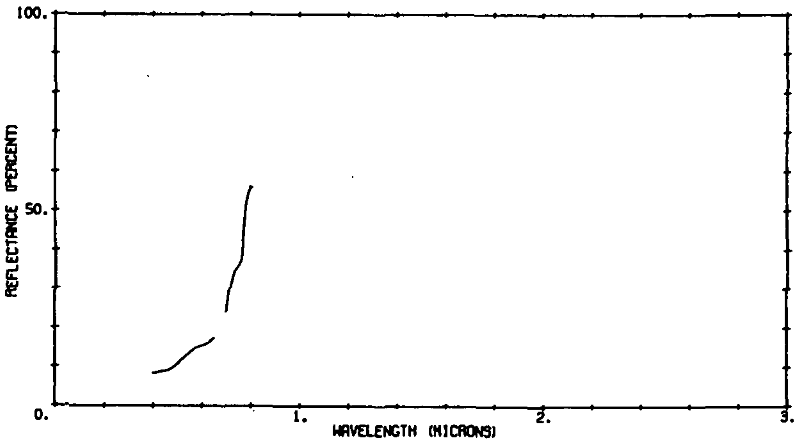
B03995 314

CLIFFS, BARE, DRY, ON MOUNTAIN TOPS, BARE DRY, NORMAL, TUNDRA



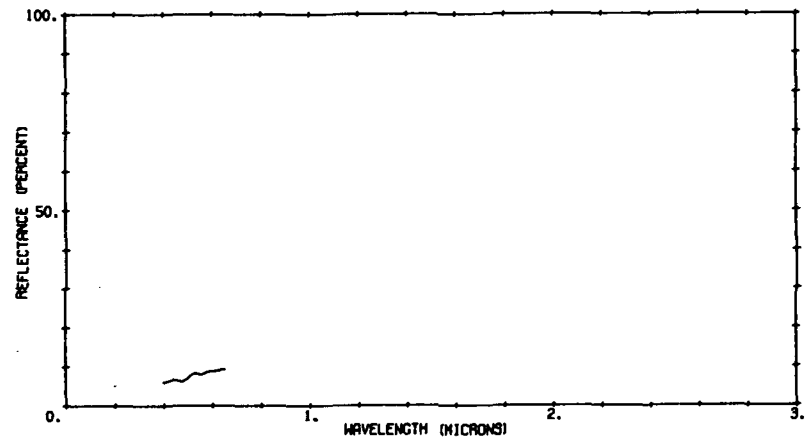
B03995 315

HILL SLOPE, BARE DRY, NORMAL STEPPE



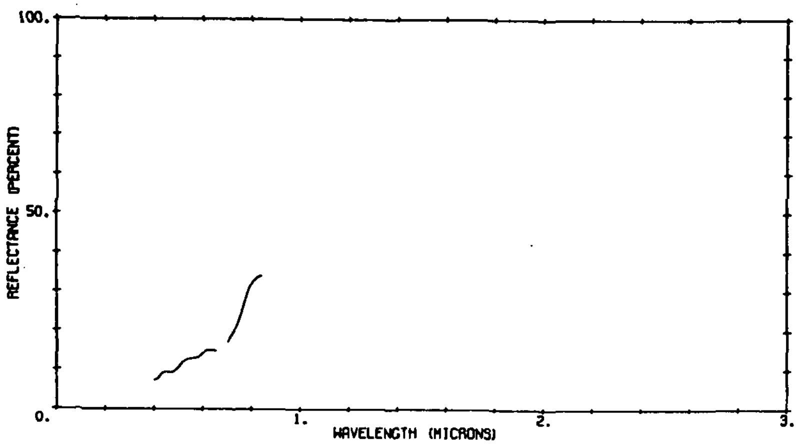
B03995 319

EARTH ROAD, HEAVILY TRAMPLED, BLACK EARTH, DRY, NORMAL



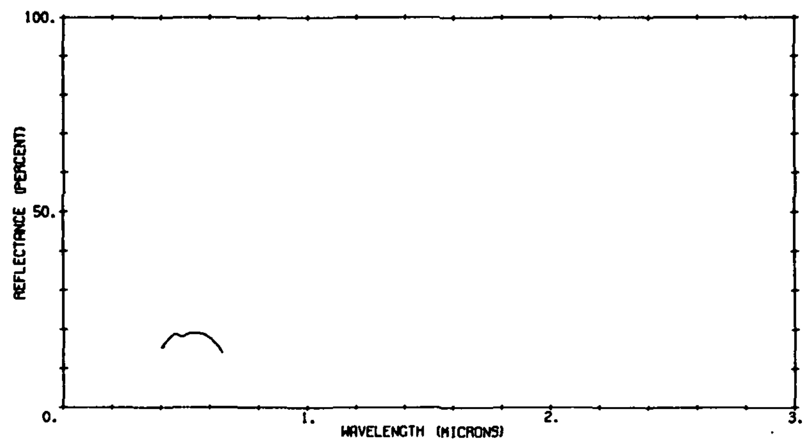
B03995 323

EARTH ROAD, BLACK EARTH, LEACHED, NORMAL STEPPE



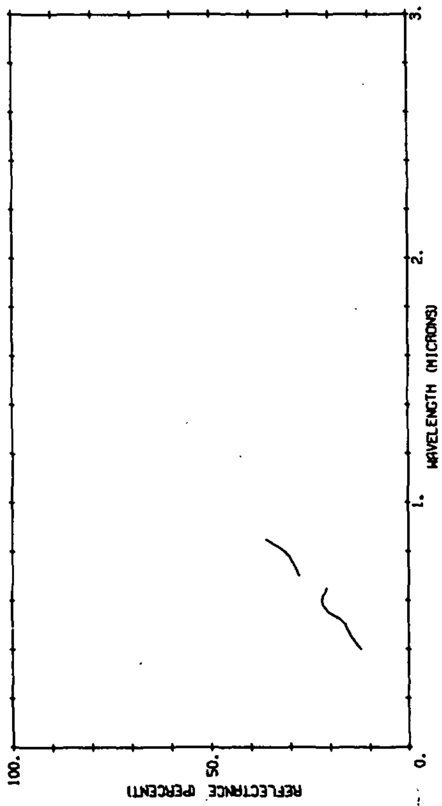
B03995 324

EARTH ROAD, LITTLE USED, CHESTNUT BROWN EARTH, NORMAL



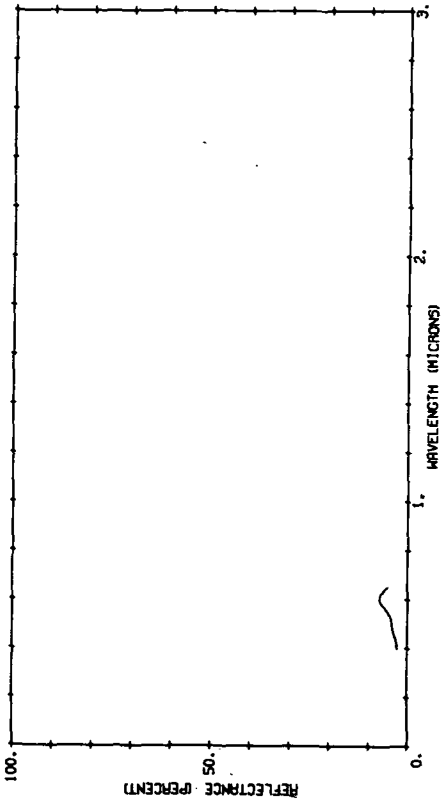
B03995 325

EARTH ROAD, TRAMPLED PODSOL, DRY, NORMAL



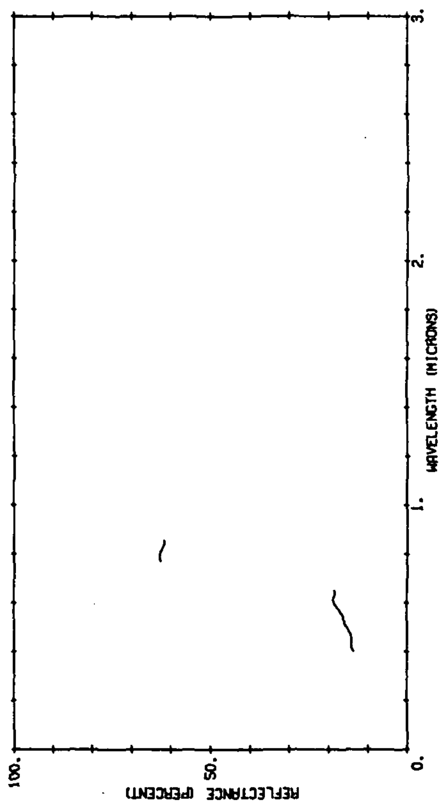
B03995 326

EARTH ROAD, MUDDY AND WET, A=90 DEGREES, ANG.=45 DEGREES



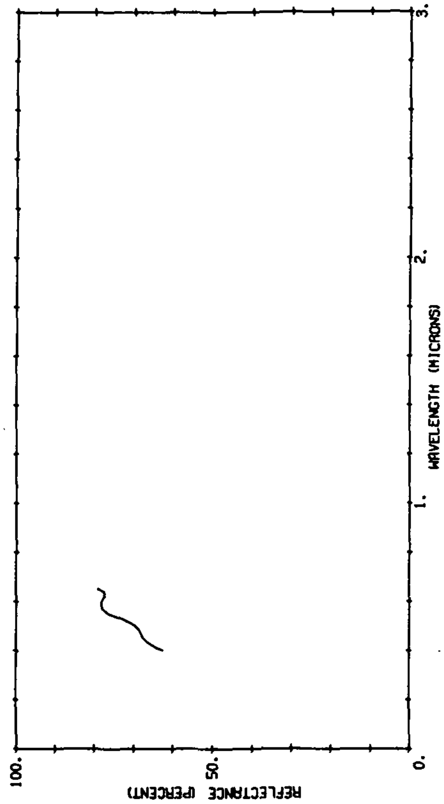
B03995 327

EARTH ROAD, COVERED WITH A LAYER OF LOESS, DRY, NORMAL, DESERT



B03995 328

ROAD, END OF WINTER, YELLOWISH AFTER RAIN, WET, NORMAL

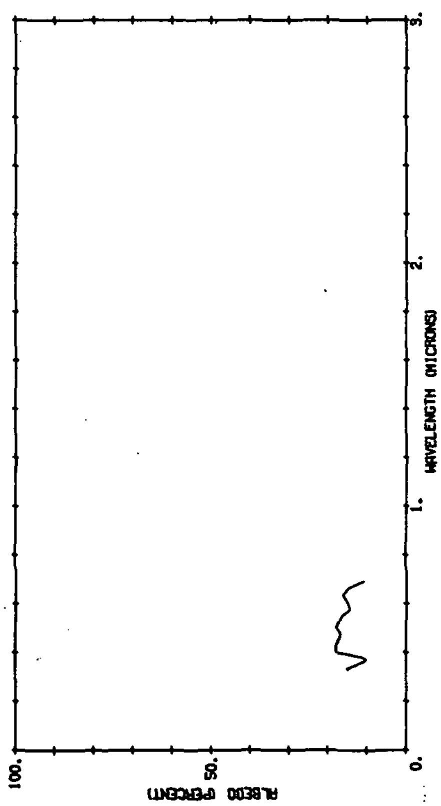


(F)BF

SOIL

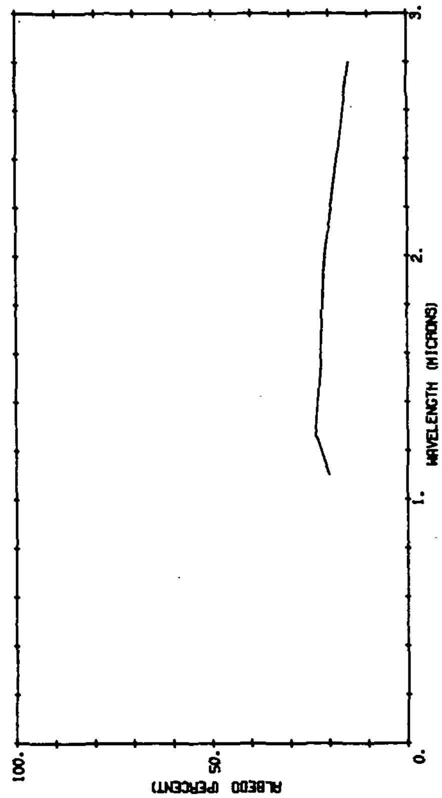
B01035 001

LAND AT 500 FT. 2/2/57 12A.M. CLOUD COVERAGE-CLEAR



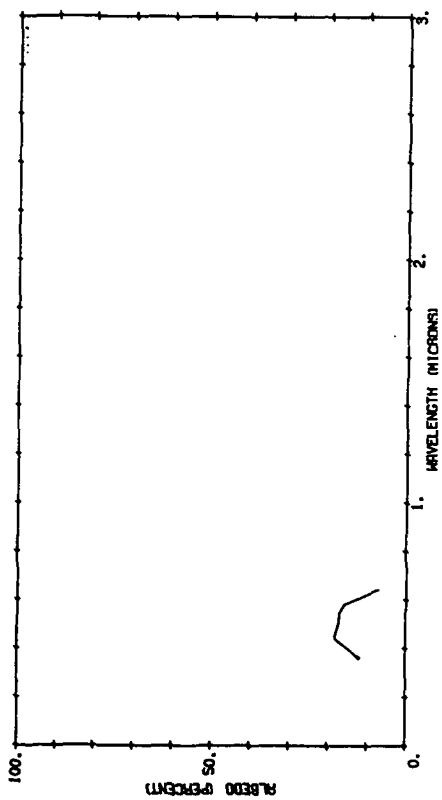
B01035 002

LAND AT 500 FT. 2/2/57 12A.M. CLOUD COVERAGE-CLEAR



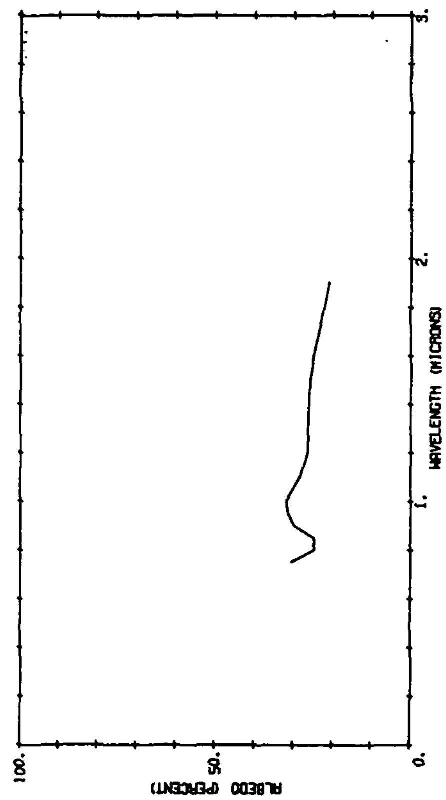
B01035 003

LAND AT 5000 FT. 2/2/57 1P.M



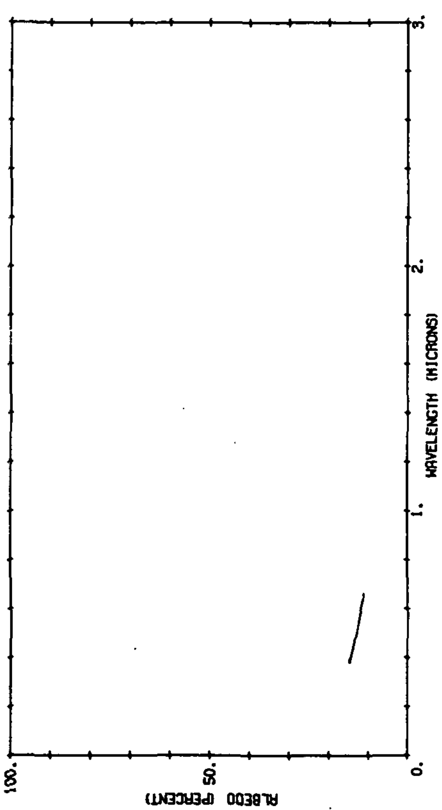
B01035 004

LAND AT 5000 FT. 2/2/57 1P.M



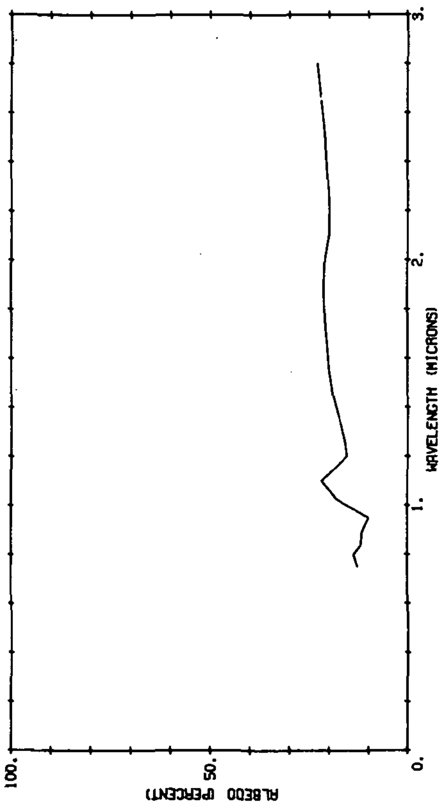
B01035 005

LAND AT 10,000 FEET 9 FEH/57 12A.M CLOUD COVERACE-CLEAR



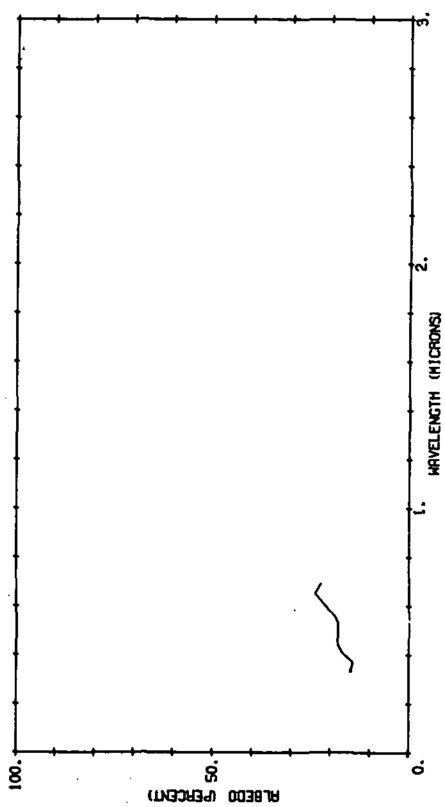
B01035 006

LAND AT 10,0GG FEET 9 FEH/57 12A.M



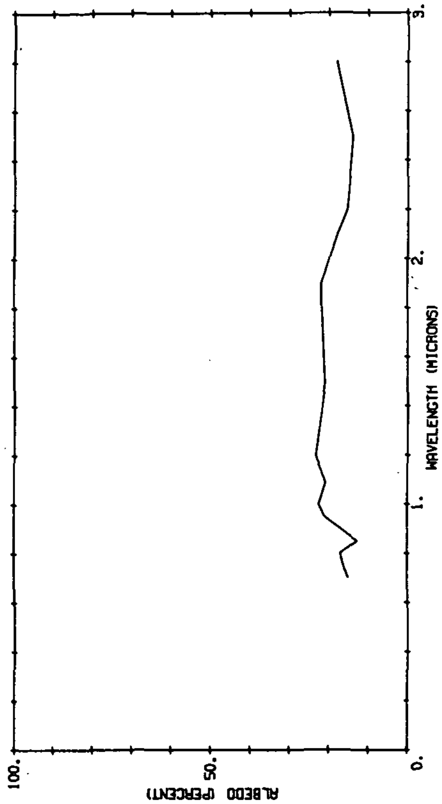
801035 007

LAND AT 15,000 FEET 5 FEB./57 1P.M. CLOUD COVER.-.1AT 5000FT



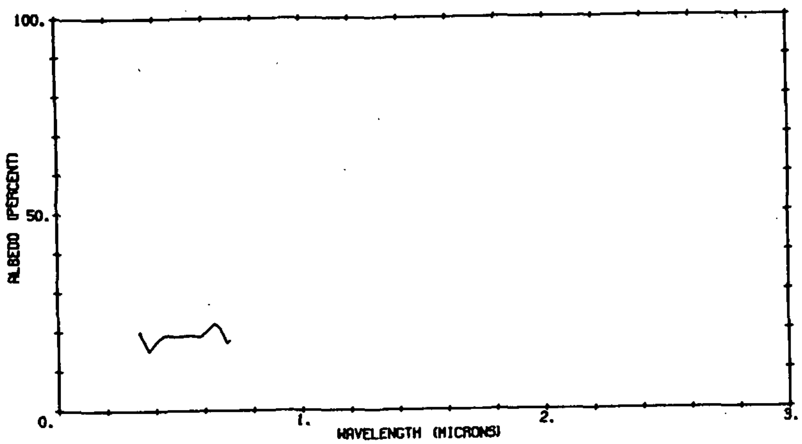
B01035 008

LAND AT 15,000 FEET 5 FEB/57 1P.M. CLOUD COVER.-.1AT 5.?.?FT



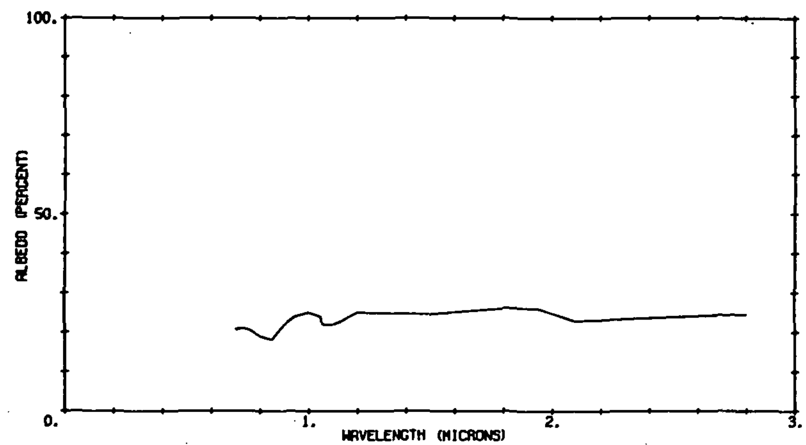
B01035 009

LAND AT 19,400 FEET 9 FEB/57 2P.M. CLOUD COVER.-.2AT 4000FT



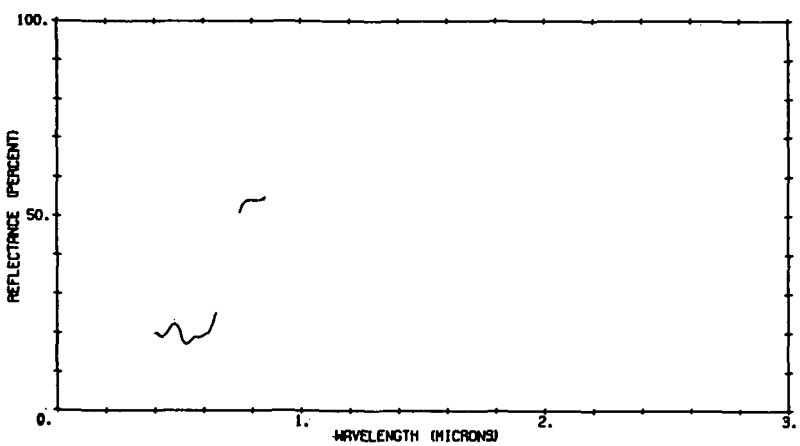
B01035 010

LAND AT 19,400 FEET 9 FEB/57 2P.M. CLOUD COVER.-.2AT 4000FT



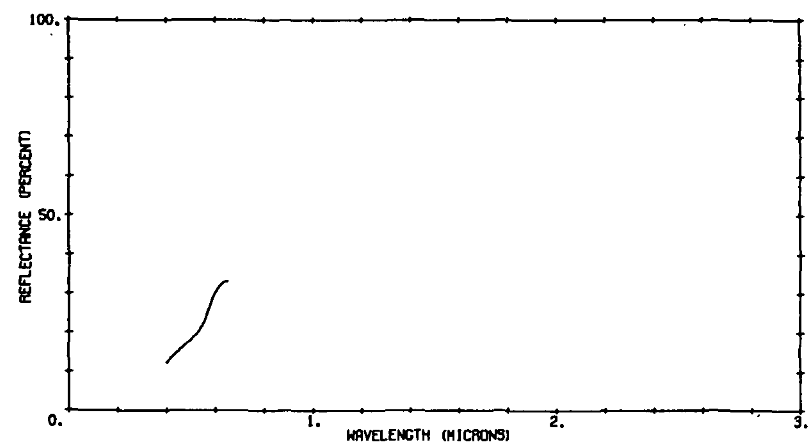
B03995 237

SILT, FROM BOTTOM OF CANAL, DRY, A=90 DEGREES, ANG.=45 DEGR
EES



B03995 238

CONGLOMERATE, DRY, INDIVIDUAL SAMPLE, A=90 DEGREES, ANG.=4
5 DEGREES

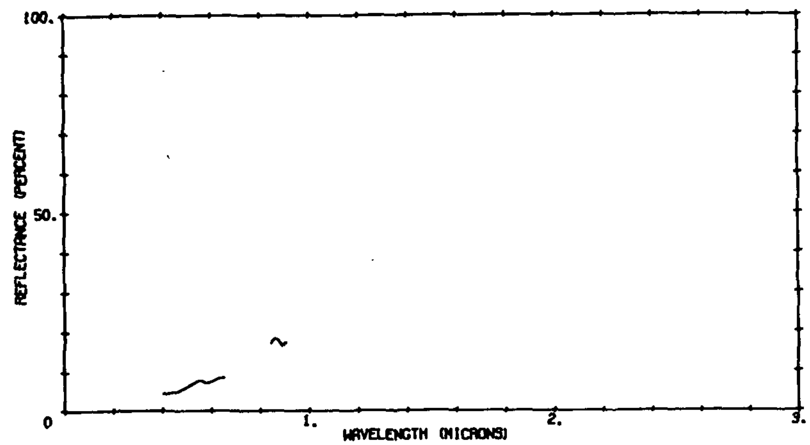


(F)BF 3

C-7

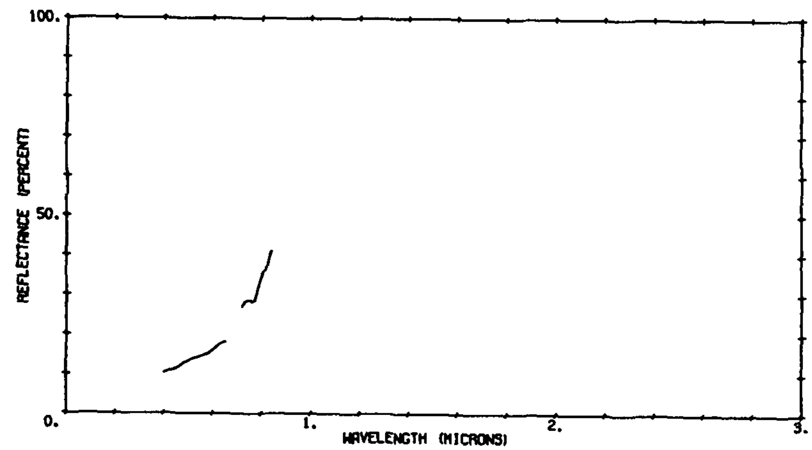
B03995 239

TURF HILLOCK, BARE, DRY, NORMAL TUNDRA



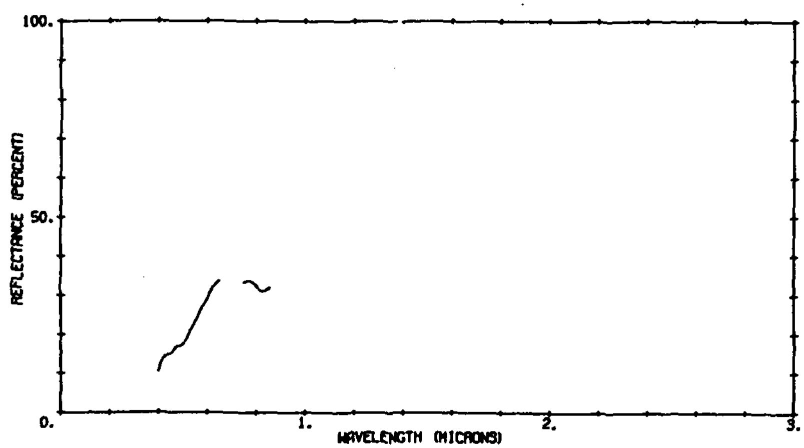
B03995 240

EDGE OF RIVER BANK, BARE, DRY, NORMAL STEPPE



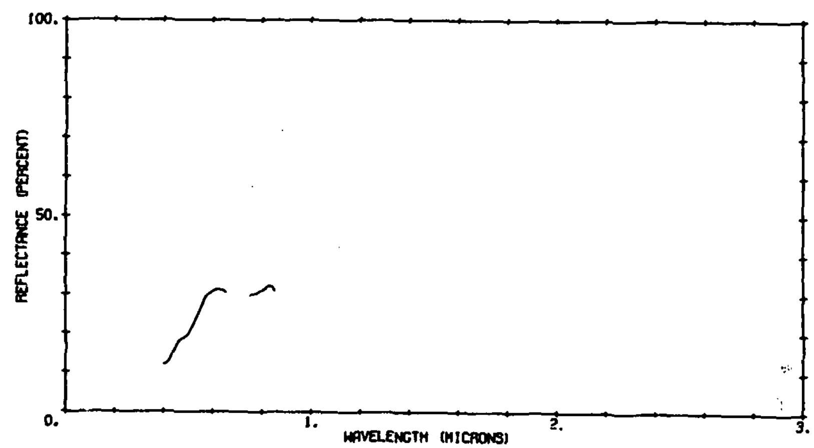
B03995 241

WIND ERODED PLACE, DRY, NORMAL, DESERT



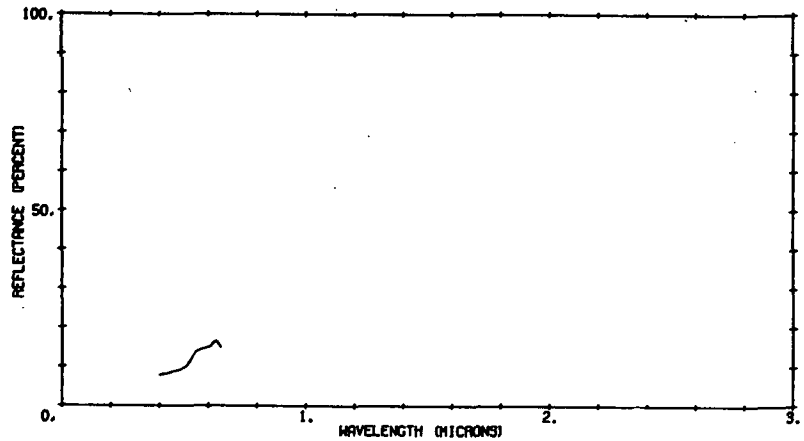
B03995 242

WIND ERODED PLACE, INDIVIDUAL SAMPLE, A=90 DEGREES, ANG.=4
5 DEGREES



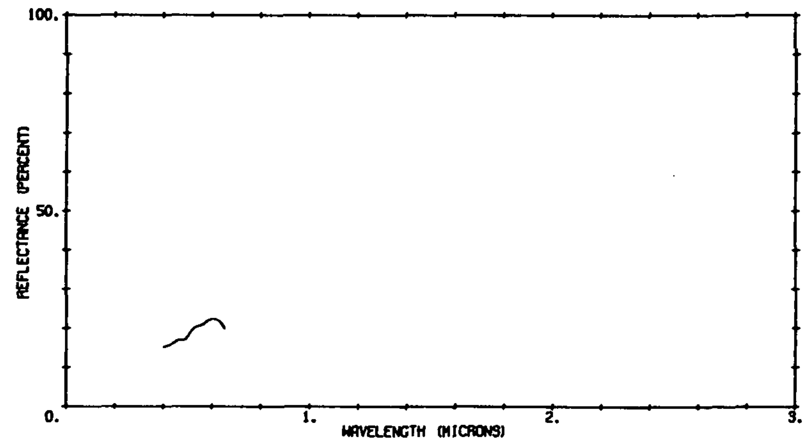
B03995 243

TALUS, MOUNTAIN SLOPES, DRY, A=130 DEGREES MOUNTAINOUS



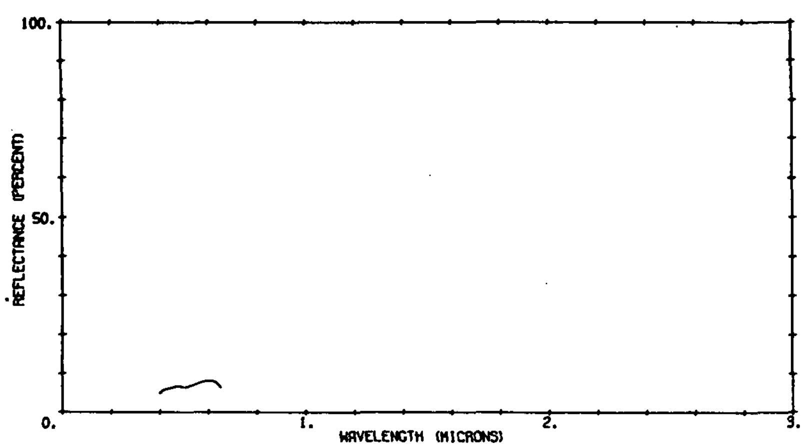
B03995 244

TALUS, MOUNTAIN SLOPES, DRY, A=100 DEGREES TUNDRA



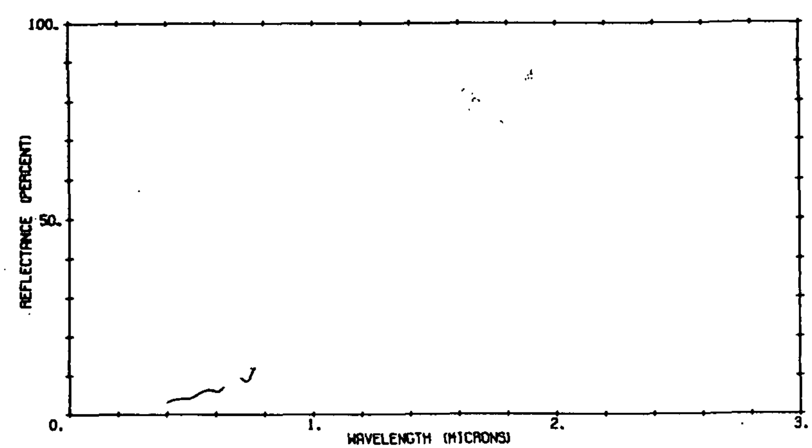
B03995 245

TALUS, MOUNTAIN SLOPES, DRY, PARTY IN SHADE A=100 DEGREES, TUNDRA



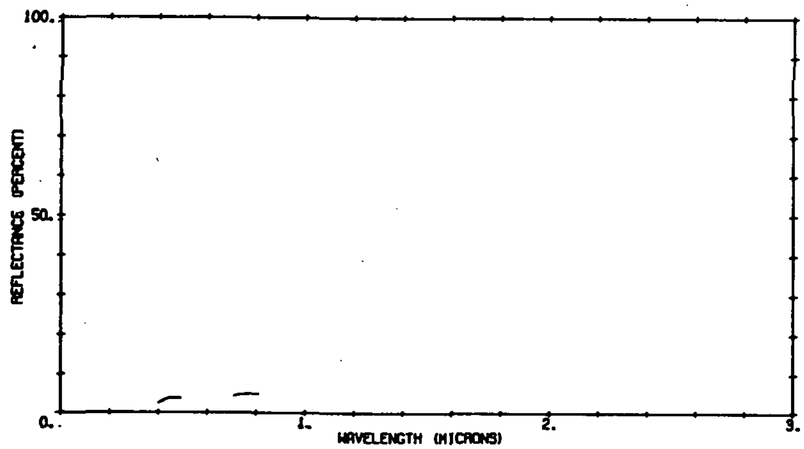
B03995 271

SOIL, BOGGY, IN BOGGY AREAS, VERY DAMP, NORMAL TUNDRA



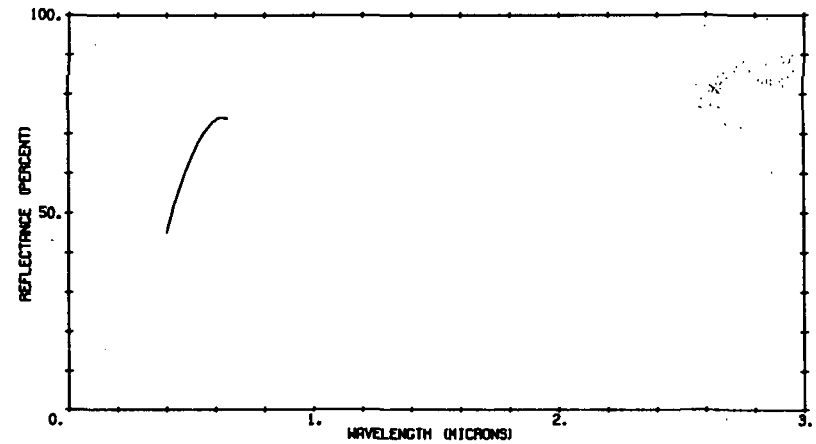
B03995 311

SOIL, CLAY LOAM, PLOUGHED, MOIST, FROM THE AIR, ALT.=3..M.



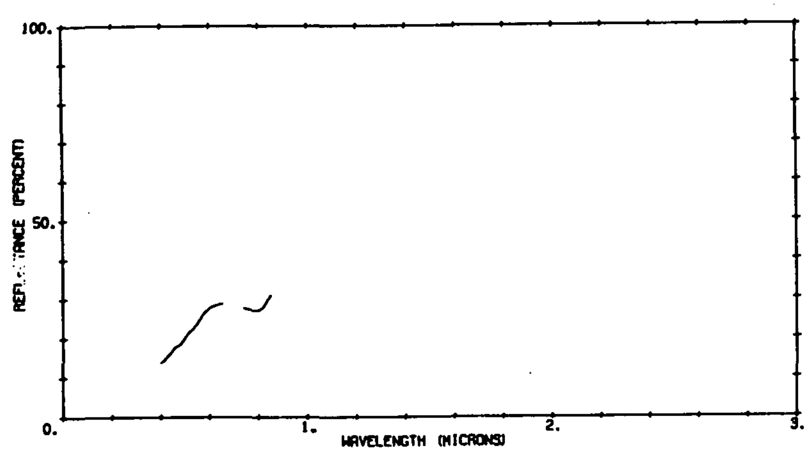
B03995 316

SHALE, INDIVIDUAL SAMPLES, DRY, A=90 DEGREES, ANG.=45 DEGR
EES, DESERT



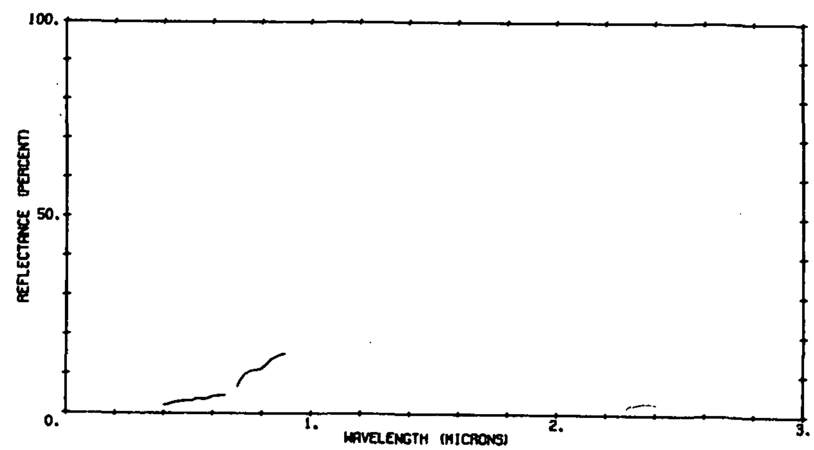
B03995 317

SALT MARSHES, INDIVIDUAL SAMPLES, DRY, A=90 DEGREES, ANG.=4
5 DEGREES



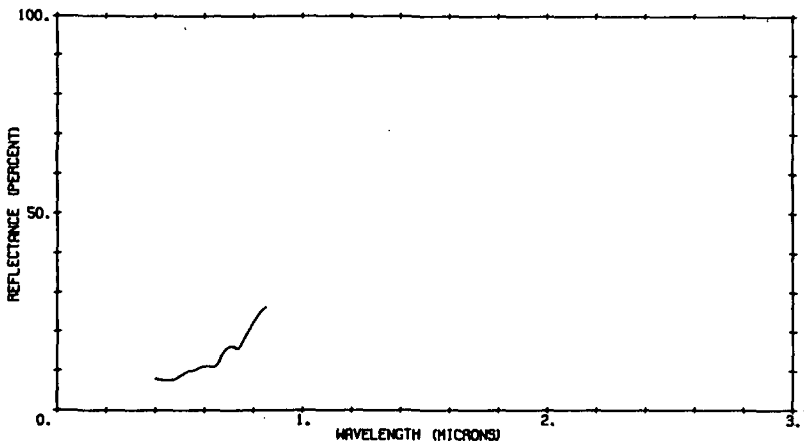
B03995 318

TURF, BARE DRY NORMALTUNDRA



B03995   322

EARTH ROAD, GREY PODSOL , NORMAL   STEPPC



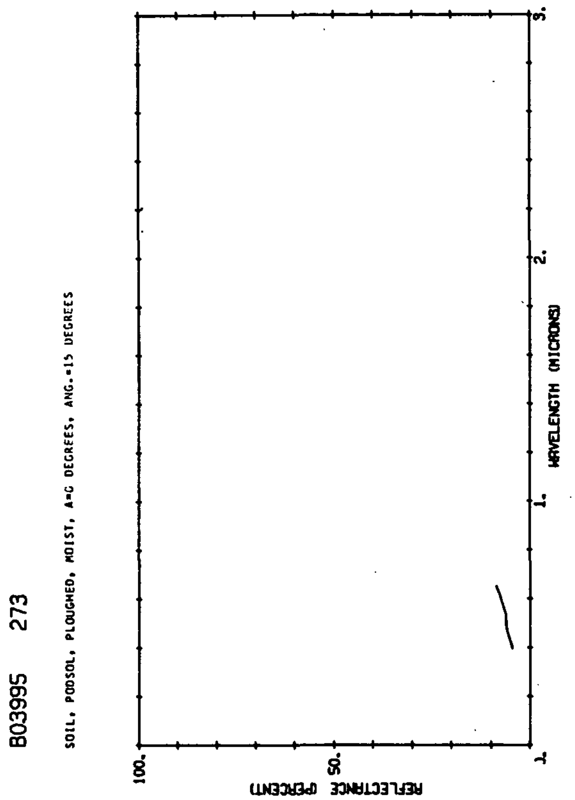
(F)BF 7

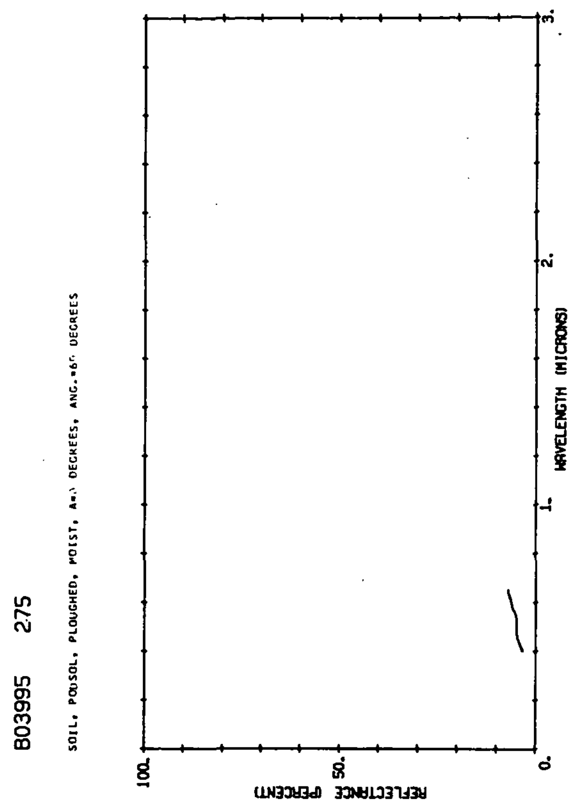
(F)BFA

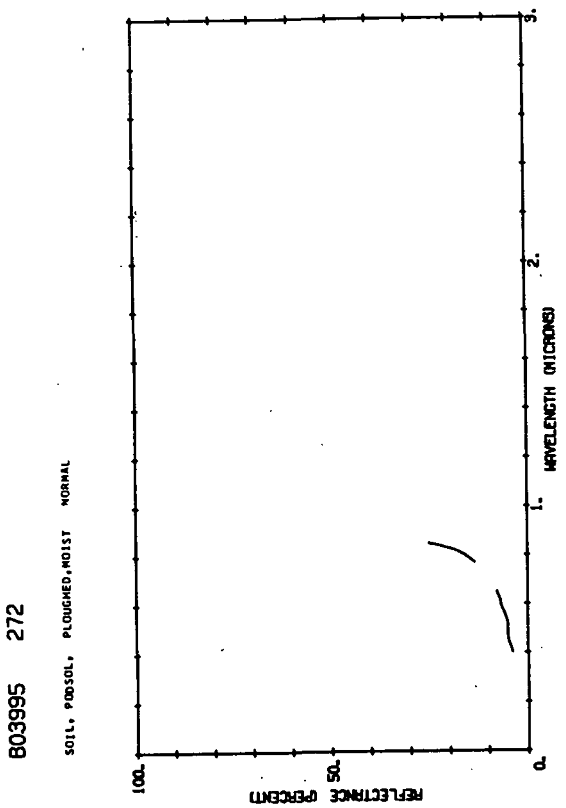
SOIL

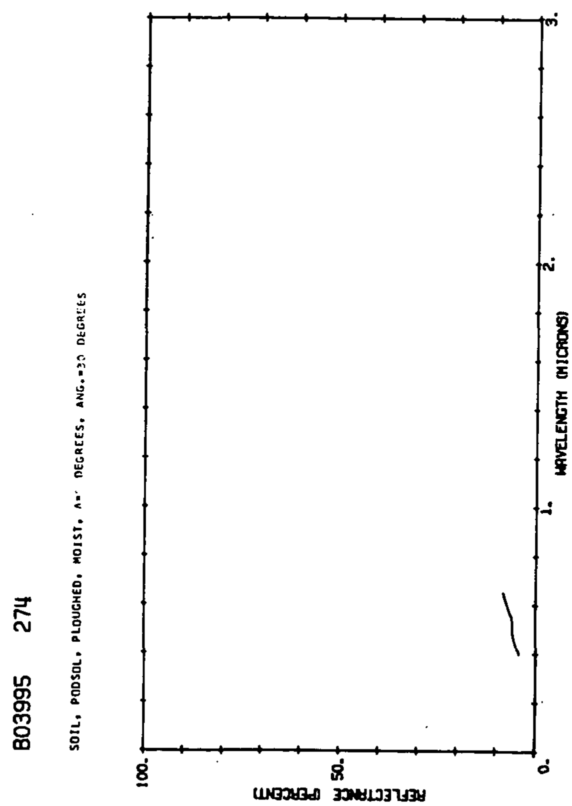
Cultivated

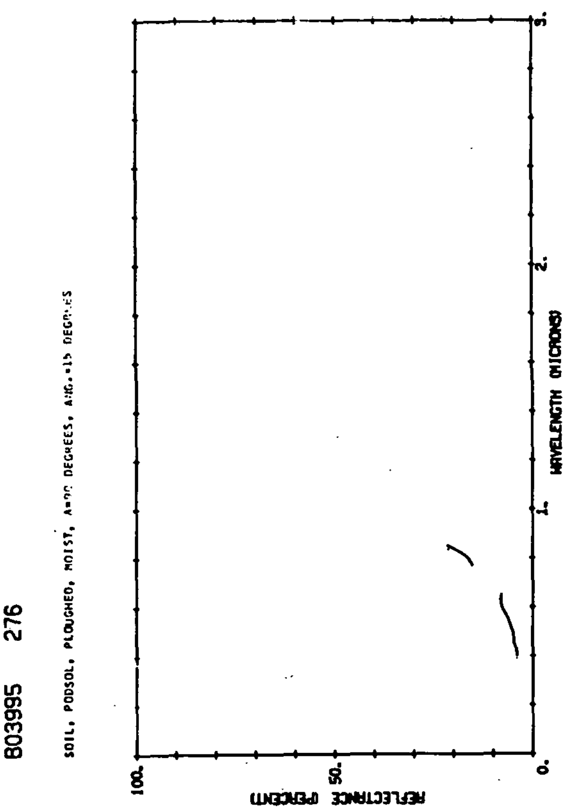
353

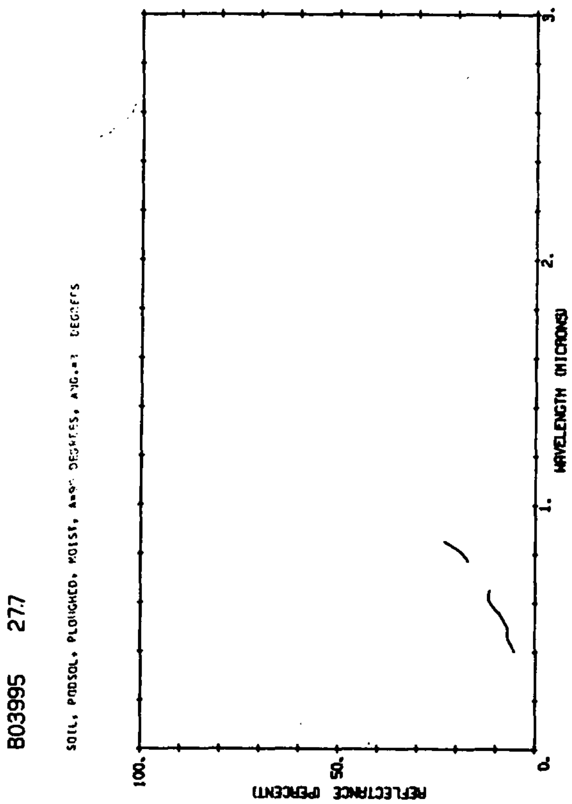

B03995 273
SOIL, PODSOL, PLOUGHED, MOIST, A=0 DEGREES, ANG.=15 DEGREES
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
.1
1.
2.
3.

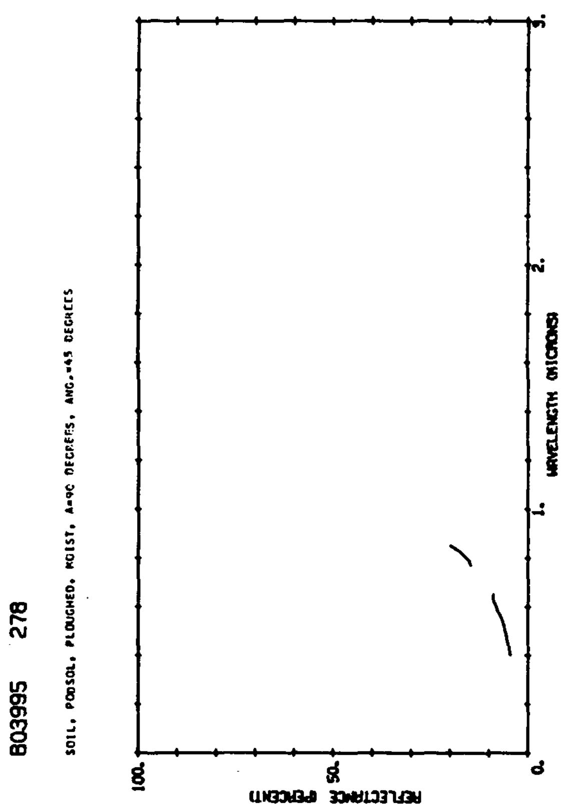

B03995 275
SOIL, PODSOL, PLOUGHED, MOIST, DEGREES, ANG.=60 DEGREES
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

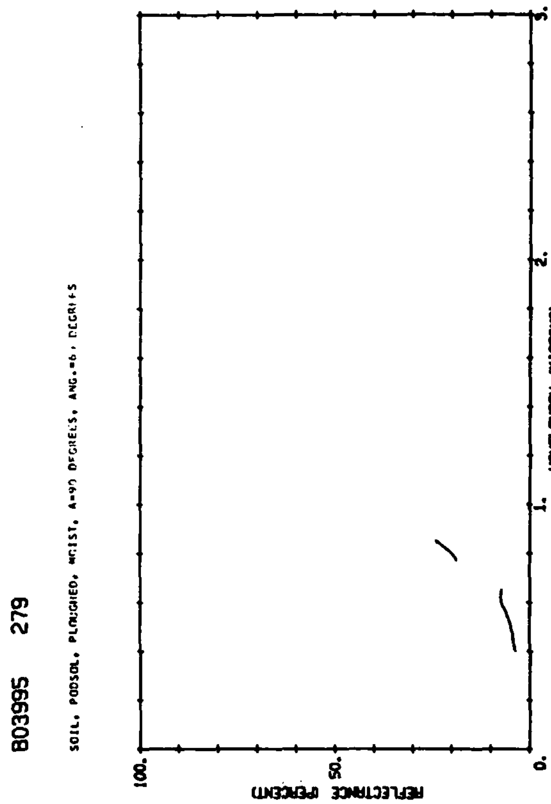

B03995 272
SOIL, PODSOL, PLOUGHED,MOIST NORMAL
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

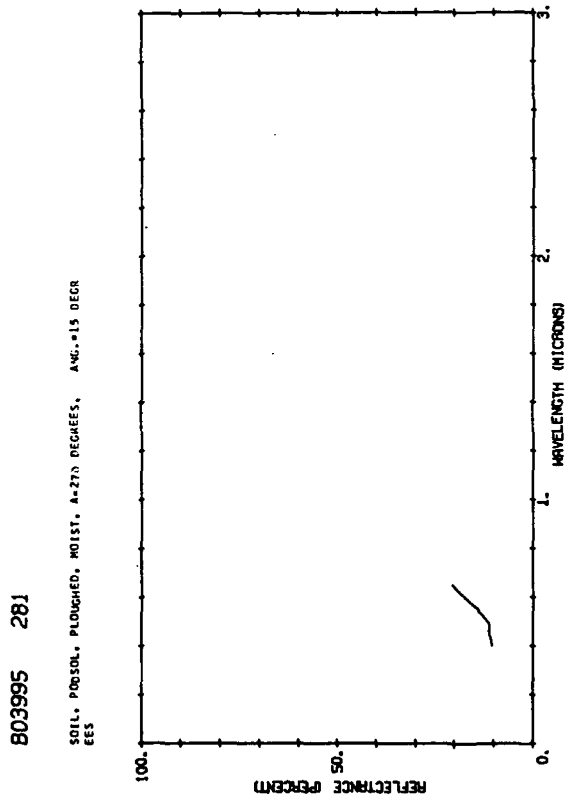

B03995 274
SOIL, PODSOL, PLOUGHED, MOIST, DEGREES, ANG.=30 DEGREES
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.


B03995 276
SOIL, PODSOL, PLOUGHED, MOIST, A=90 DEGREES, ANG.=15 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

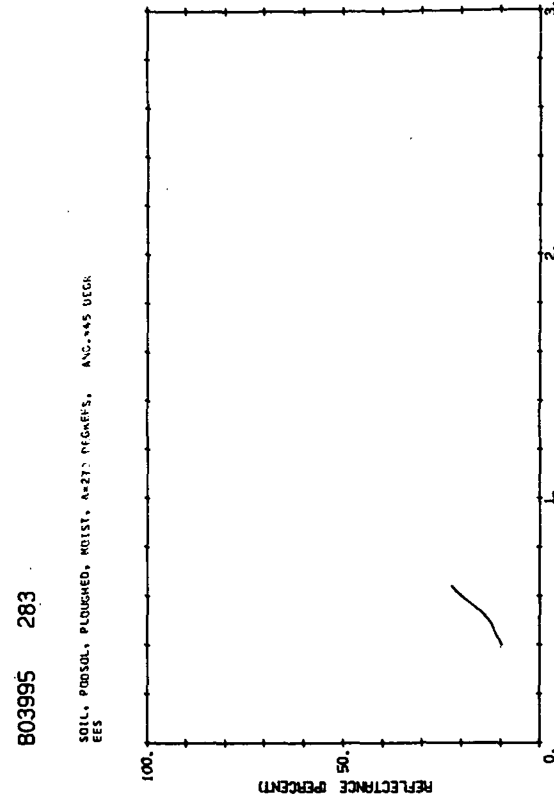

B03995 277
SOIL, PODSOL, PLOUGHED, MOIST, A=90 DEGREES, ANG.=3 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B03995 278
SOIL, PODSOL, PLOUGHED, MOIST, A=90 DEGREES, ANG.=45 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

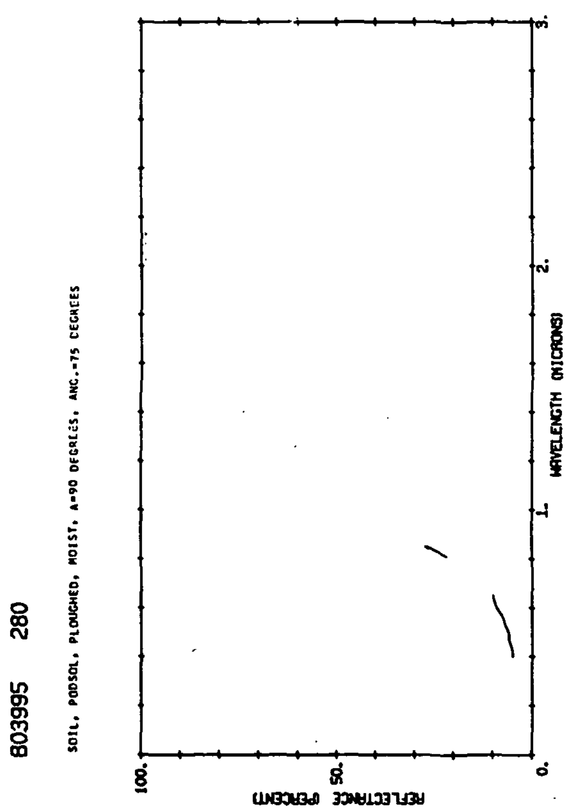

B03995 279
SOIL, PODSOL, PLOUGHED, MOIST, A=90 DEGREES, ANG.=6, DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.



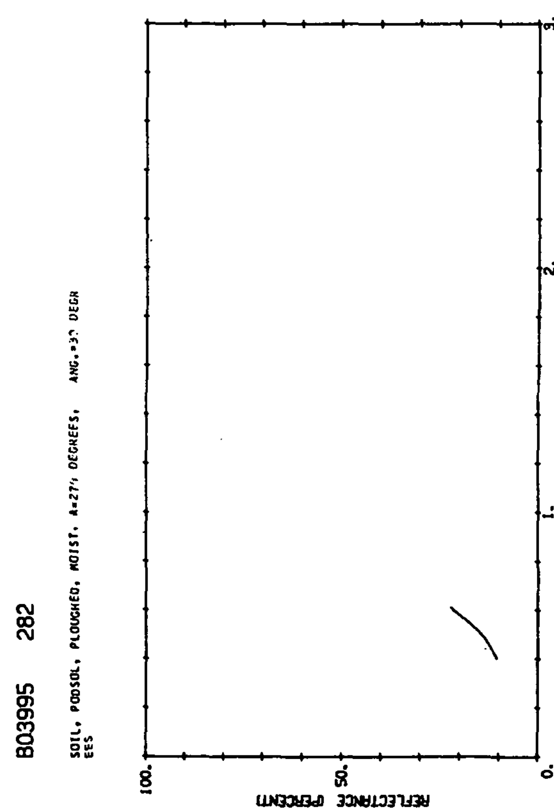
B03995 281
SOIL, PODSOL, PLOUGHED, MOIST, A=270 DEGREES, ANG.=15 DEGR
EES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.



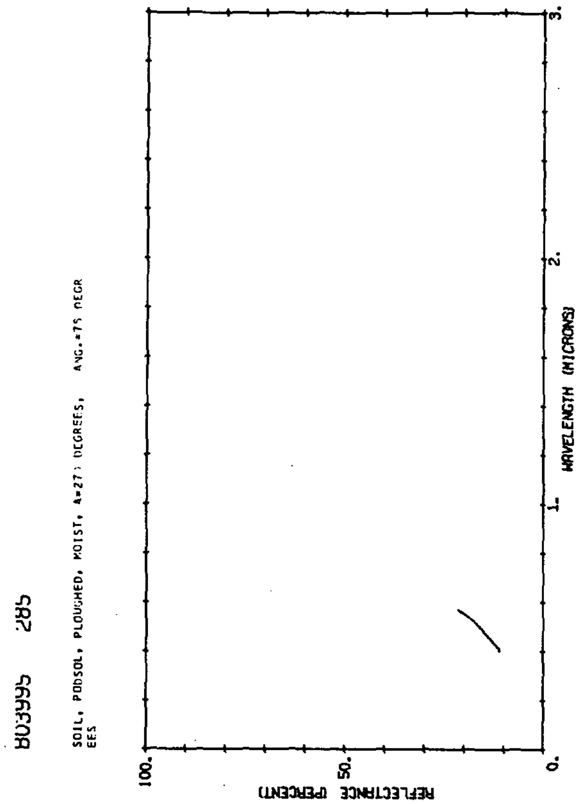
B03995 283
SOIL, PODSOL, PLOUGHED, MOIST, A=27? DEGREES, ANG.=45 DEGR
EES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

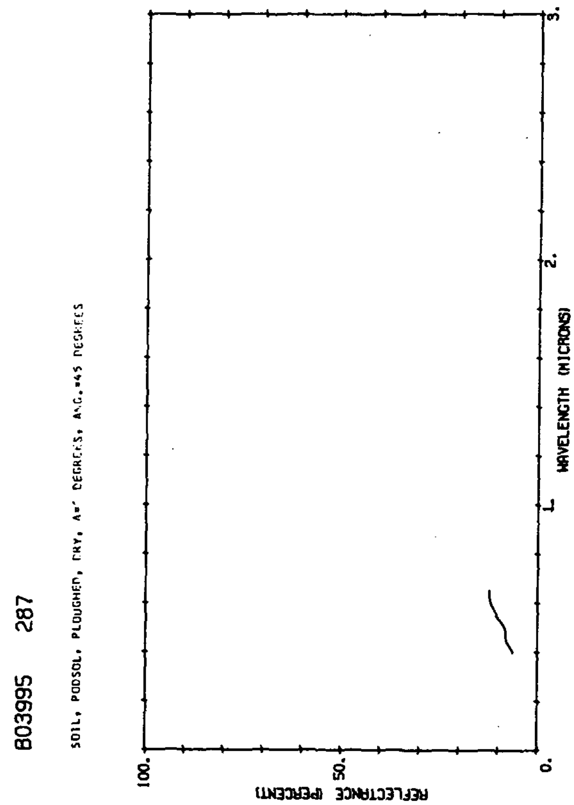


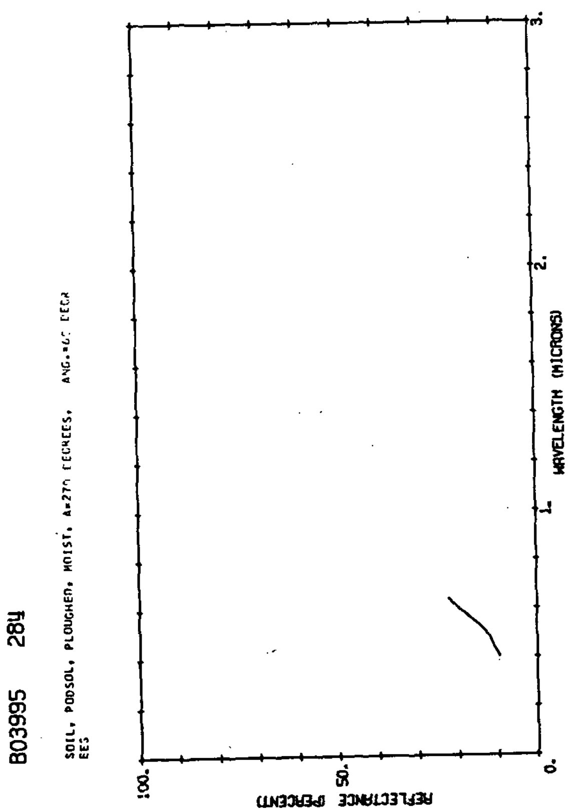
B03995 280
SOIL, PODSOL, PLOUGHED, MOIST, A=90 DEGREES, ANG.=75 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

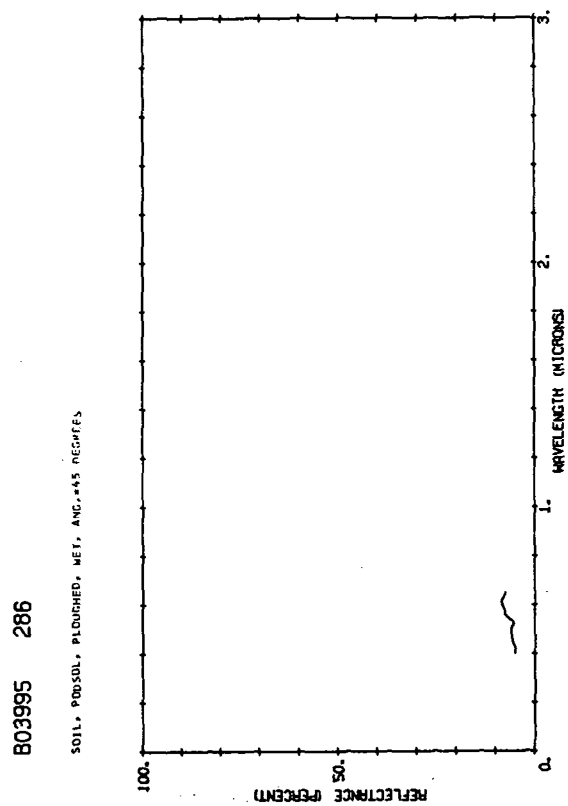


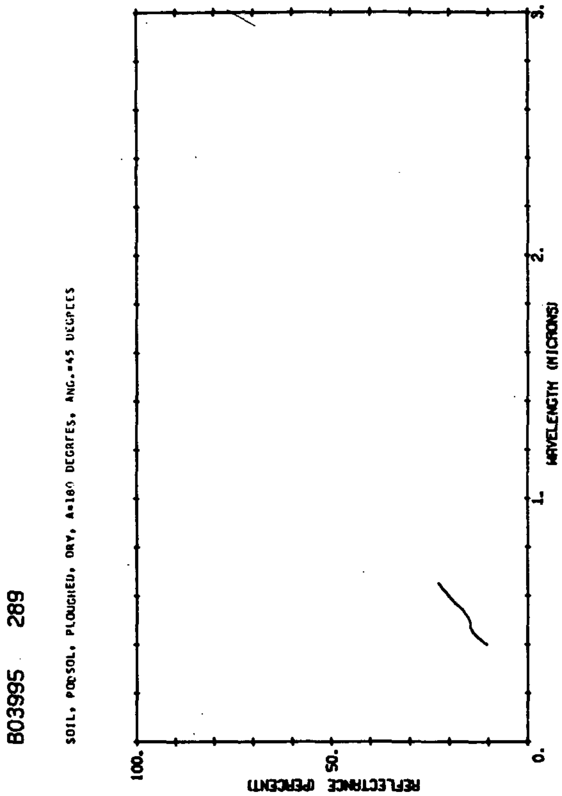
B03995 282
SOIL, PODSOL, PLOUGHED, MOIST, A=27? DEGREES, ANG.=3? DEGR
EES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

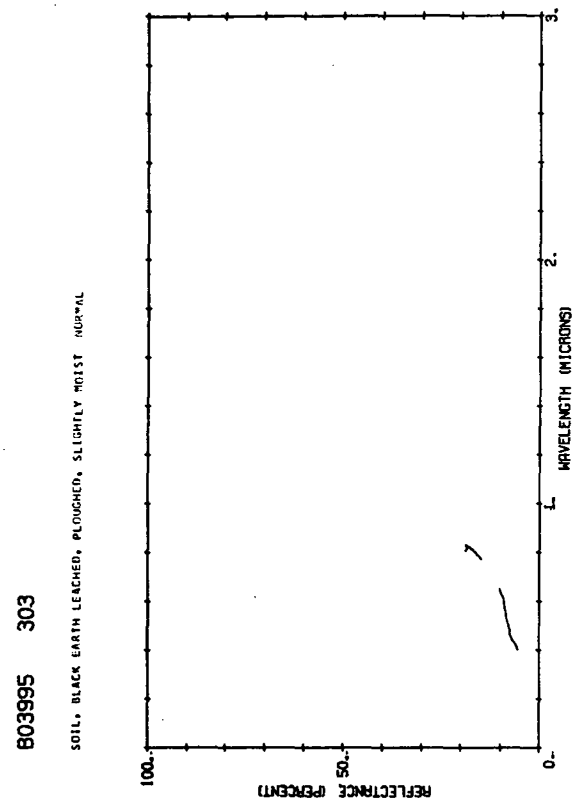

B03995 285
SOIL, PODSOL, PLOUGHED, MOIST
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

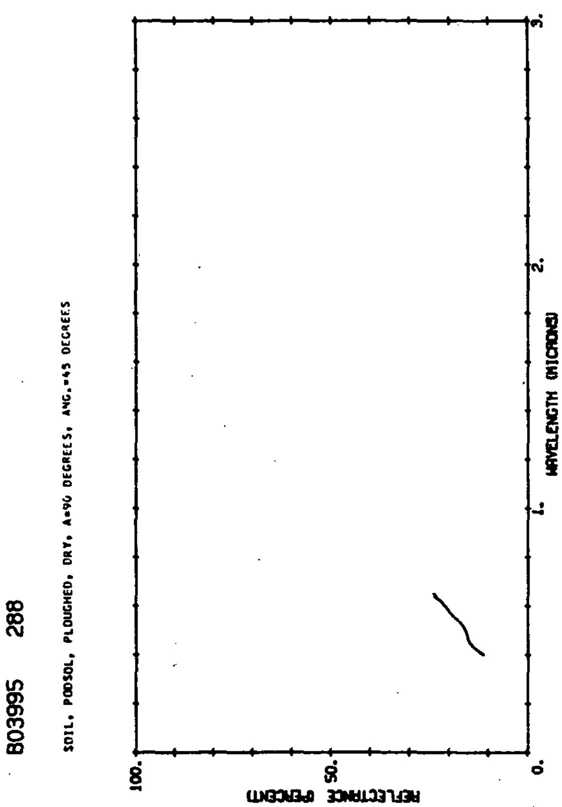

B03995 287
SOIL, PODSOL, PLOUGHED, DRY
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

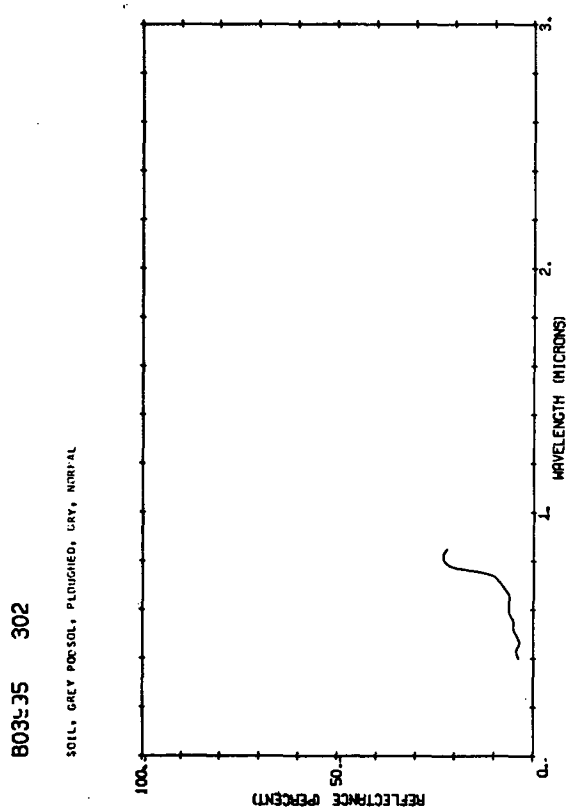

B03995 284
SOIL, PODSOL, PLOUGHED, MOIST
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

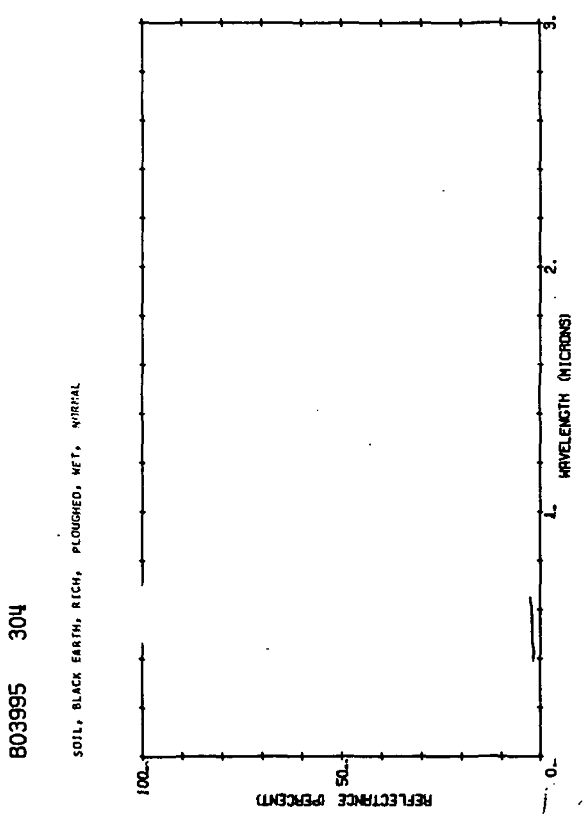

B03995 286
SOIL, PODSOL, PLOUGHED, WET, ANG.=45 DEGREES
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

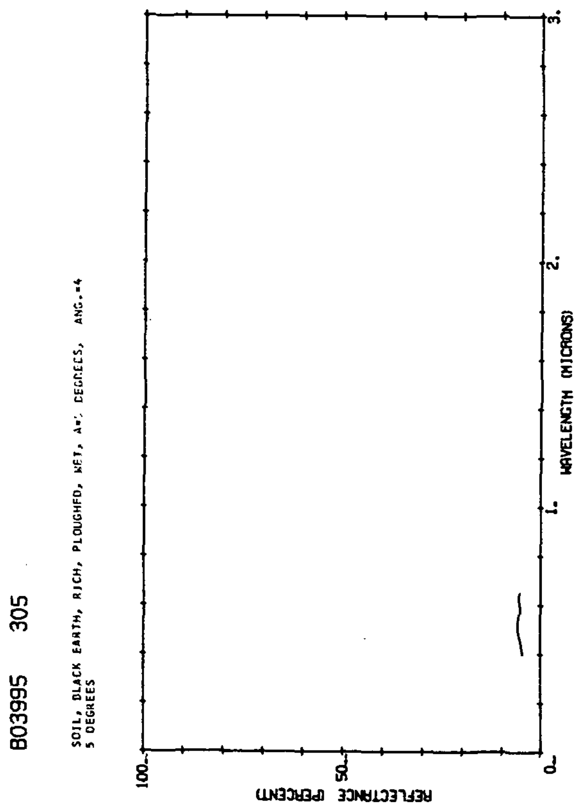

B03995 289
SOIL, PODSOL, PLOUGHED, DRY, A=180 DEGREES, ANG.=45 DEGREES
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)

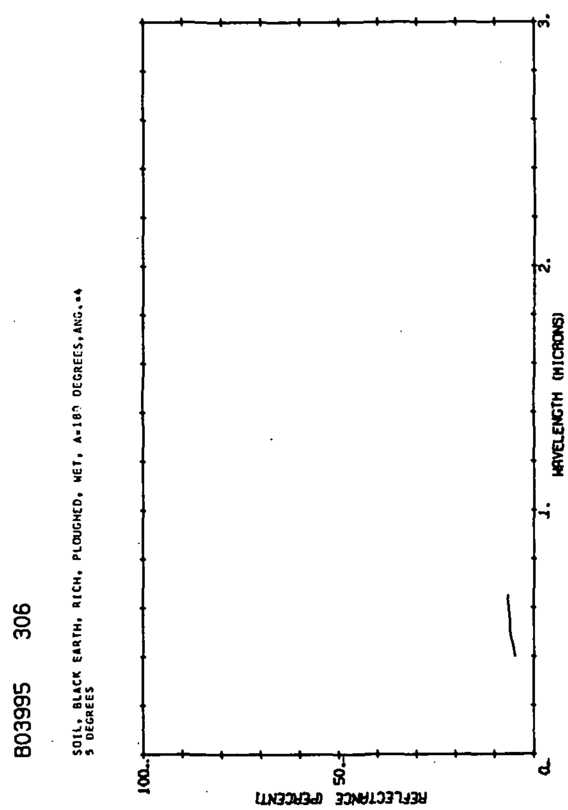

B03995 303
SOIL, BLACK EARTH LEACHED, PLOUGHED, SLIGHTLY MOIST
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)

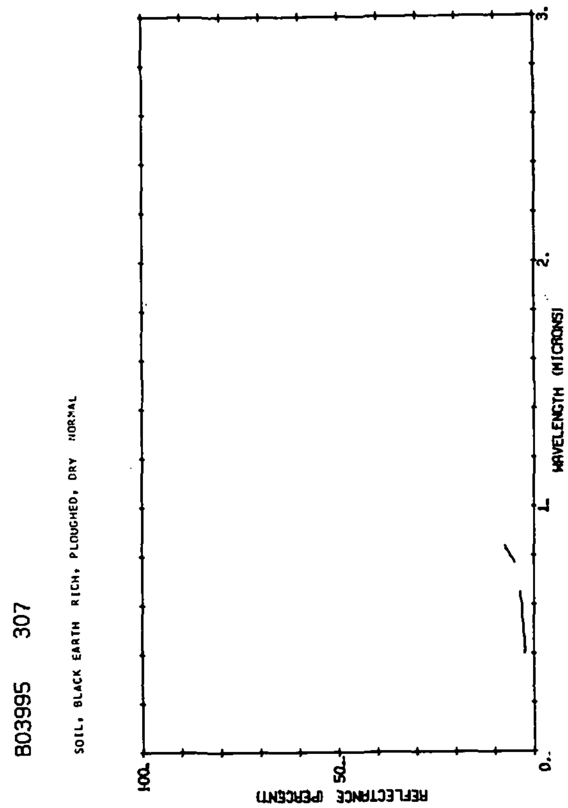

B03995 288
SOIL, PODSOL, PLOUGHED, DRY, A=90 DEGREES, ANG.=45 DEGREES
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)


302
SOIL, GREY PODSOL, PLOUGHED
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)


B03995 304
SOIL, BLACK EARTH, RICH, PLOUGHED, WET, NORMAL
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

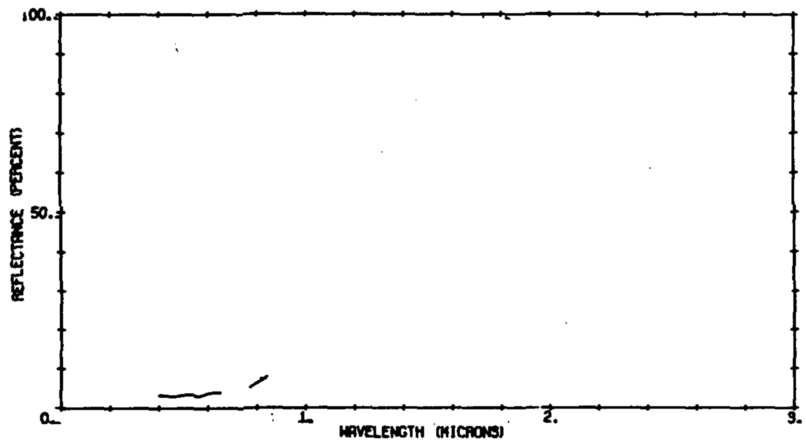

B03995 305
SOIL, BLACK EARTH, RICH, PLOUGHED, WET, DEGREES, ANG.=4
5 DEGREES
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B03995 306
SOIL, BLACK EARTH, RICH, PLOUGHED, WET, DEGREES,ANG.=4
5 DEGREES
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B03995 307
SOIL, BLACK EARTH RICH, PLOUGHED, DRY NORMAL
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

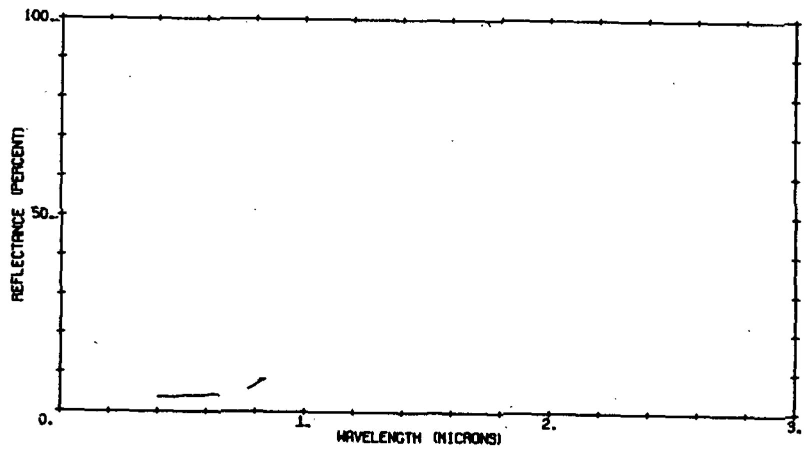
B03995 308

SOIL, BLACK EARTH, RICH, PLOUGHED, DRY, A=0 DEGREES, ANG.=4
5 DEGREES



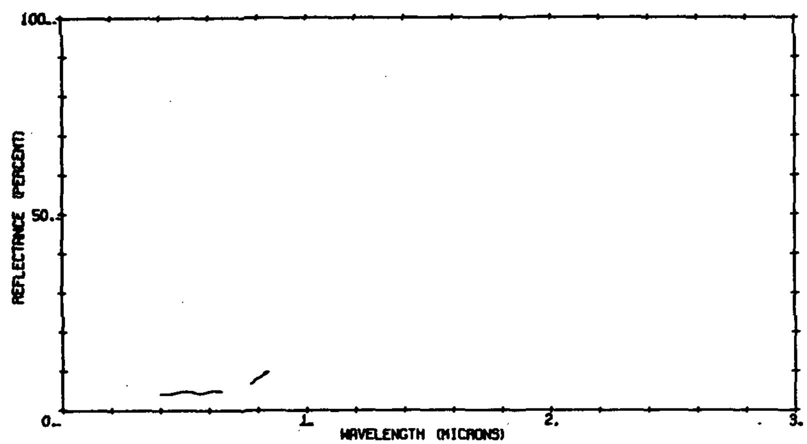
B03995 309

SOIL, BLACK EARTH, RICH, PLOUGHED, DRY, A=90 DEGREES, ANG.=4
5 DEGREES



B03995 310

SOIL, BLACK EARTH, RICH, PLOUGHED, DRY, A=180 DEGREES,ANG.=4
5 DEGREES



(F)BFCA

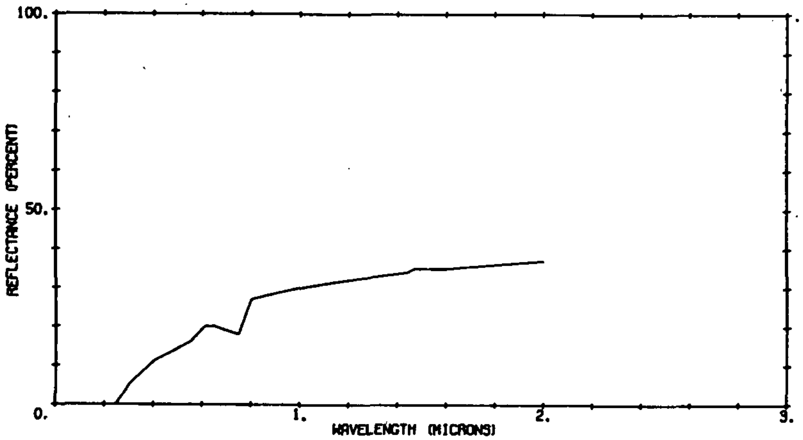
SOIL

Sand

361

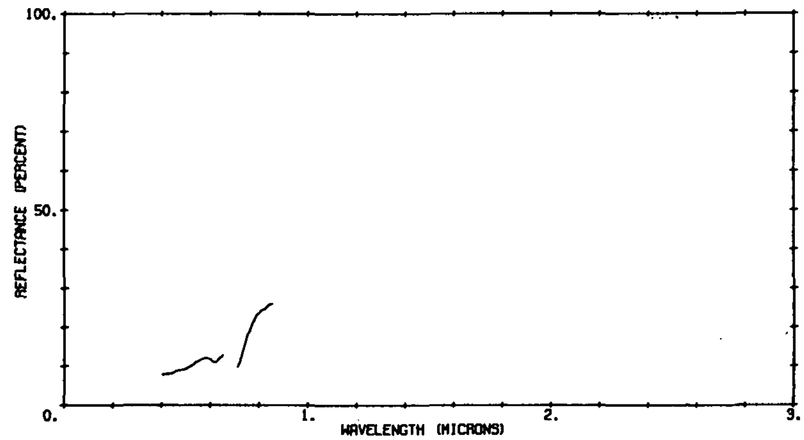
B01337 025

RED DESERT SOIL



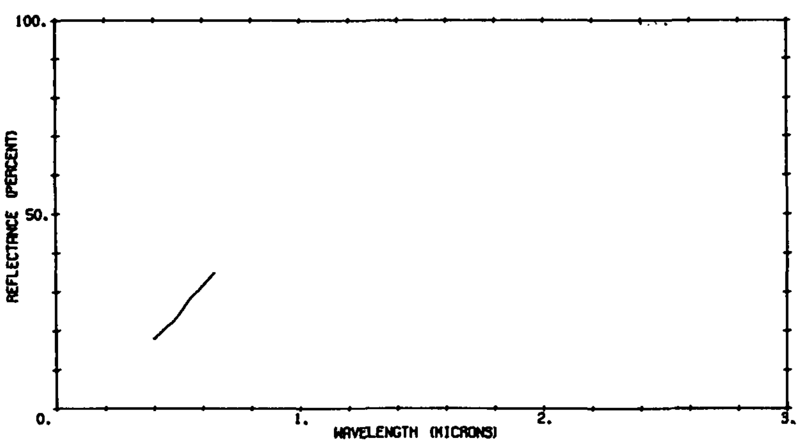
B03995 246

SHALLOWS, SAND WITH PEBBLES, MOIST, ALMOST PLUMH STEPPE



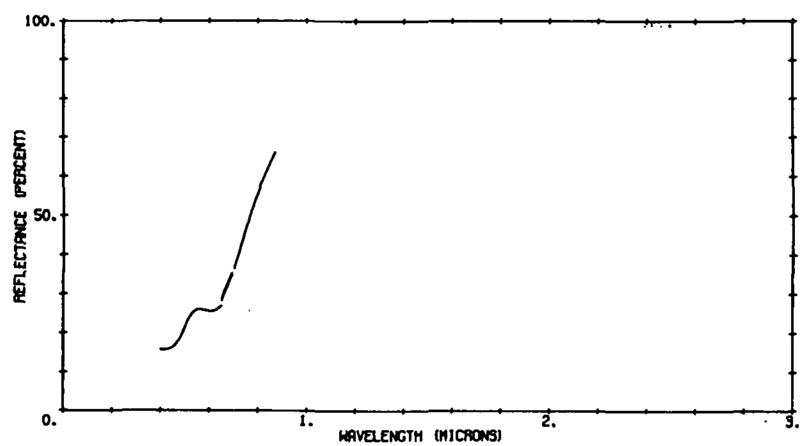
B03995 247

SAND, INDIVIDUAL SAMPLE, A=90 DEGREES, ANG.=45 DEGREES
DESERT



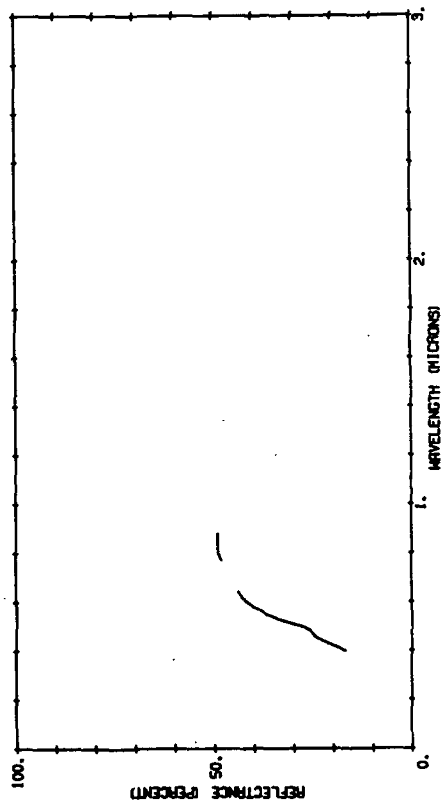
B03995 248

SAND DUNES, WITH SHARPLY EXPRESSED MICRORELIEF, DRY, NO SHA
DOWS, NORMAL DESERT



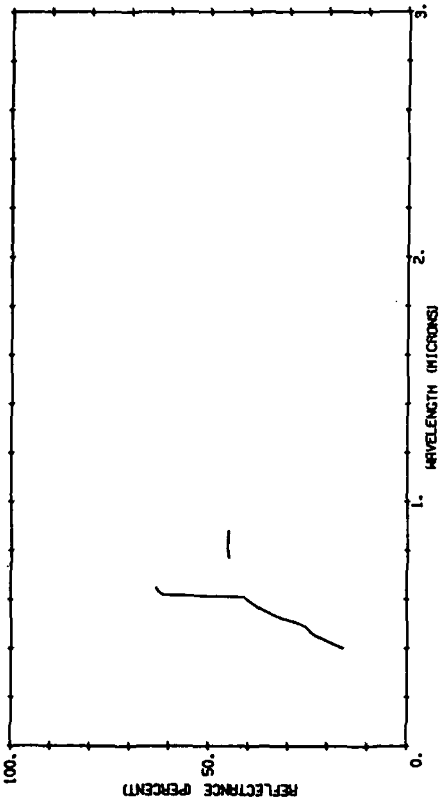
B03995 249

SAND DUNES, HEAVY EXPRESSED MICRORELIEF,DRY, A=90 DEGREES,
ANG.=30 DEGREES



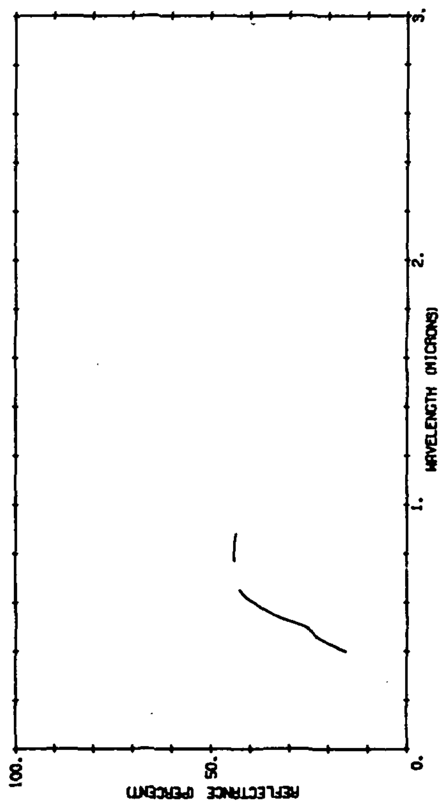
B03995 250

SAND DUNE, HEAVY EXPRESSED MICRORELIEF,DRY A=90 DEGREES,
ANG.=60 DEGREES



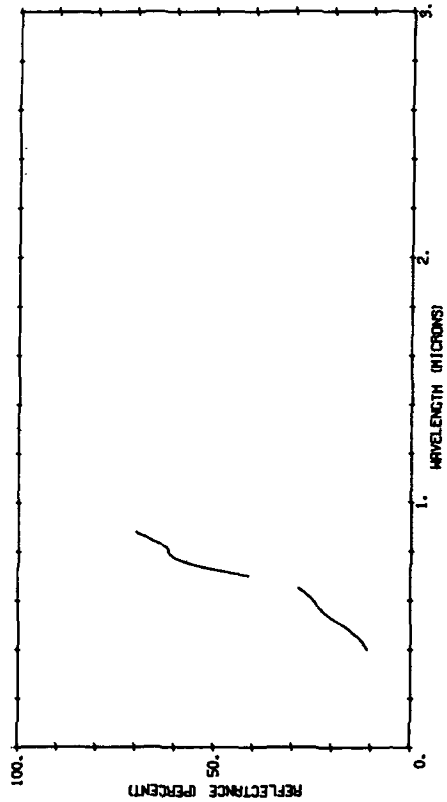
B03995 251

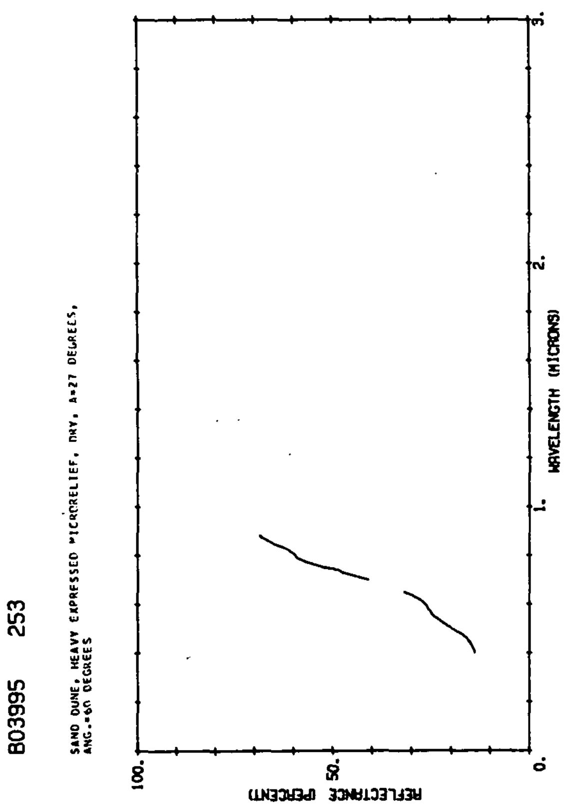
SAND DUNE, HEAVY EXPRESSED MICROPELIEF, DRY, A=90 DEGREES,
ANG.=75 DEGREES

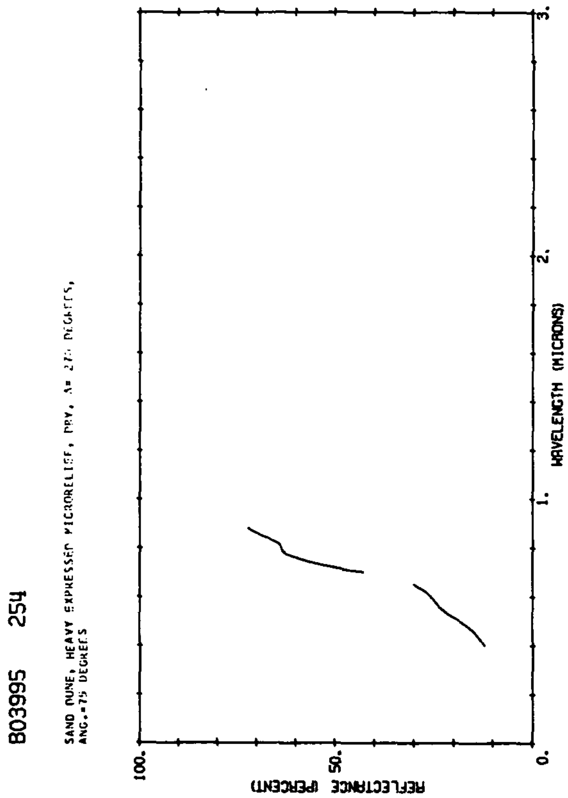


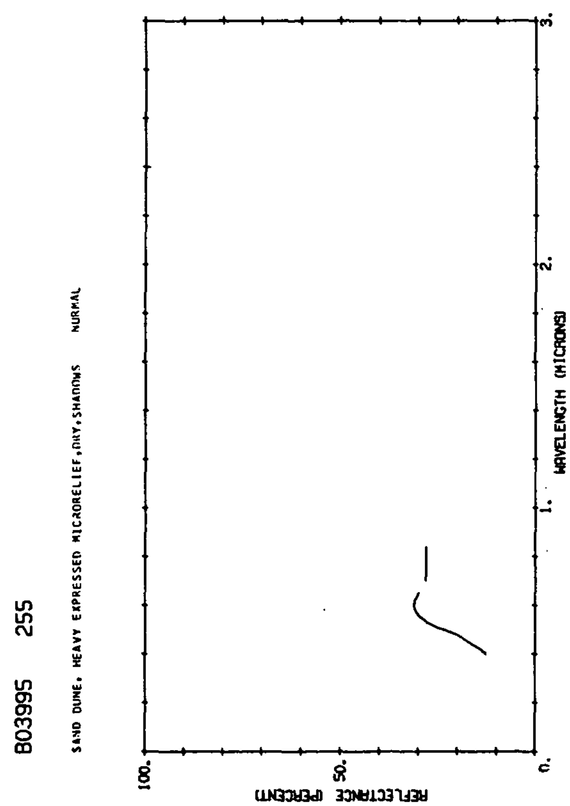
B03995 252

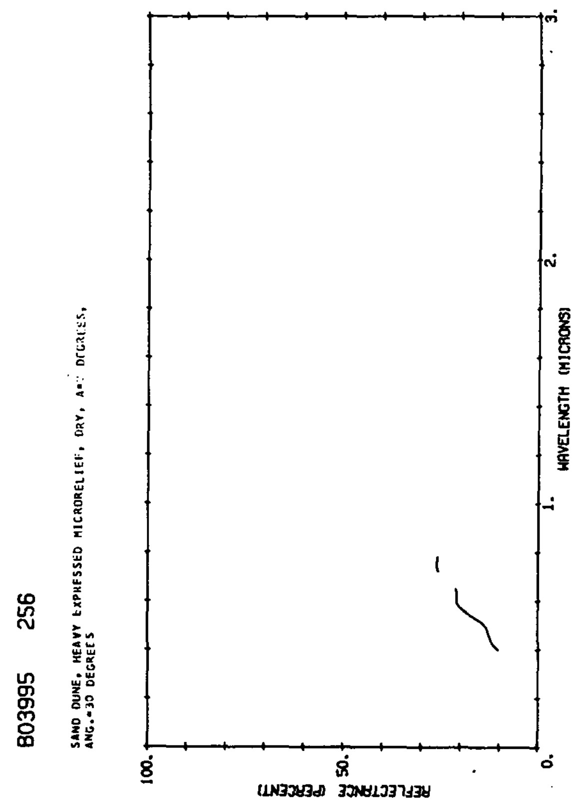
SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=270 DEGREES,
ANG.=30 DEGREES




B03995 253
SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=27 DEGREES,
ANG.=60 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

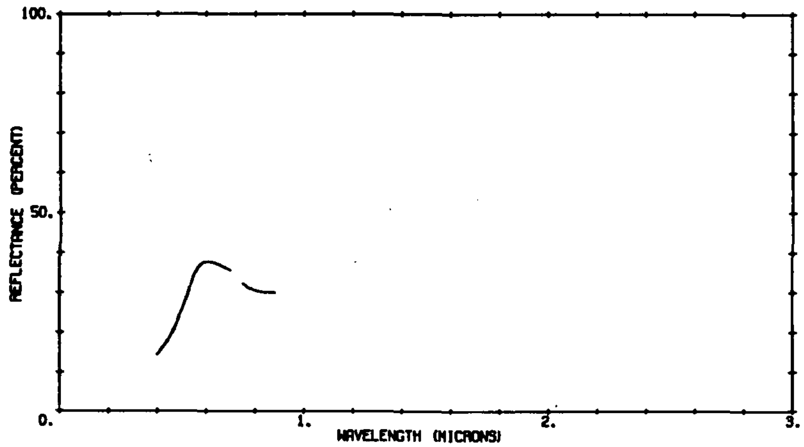

B03995 254
SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY,
ANG.=75 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B03995 255
SAND DUNE, HEAVY EXPRESSED MICRORELIEF,DRY,SHADOWS NORMAL
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B03995 256
SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY,
ANG.=30 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

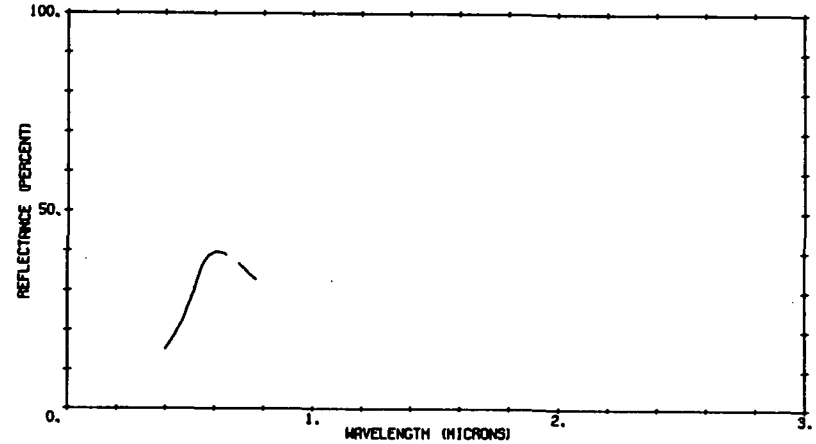
B03995 257

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=0 DEGREES,
ANG.=60 DEGREES



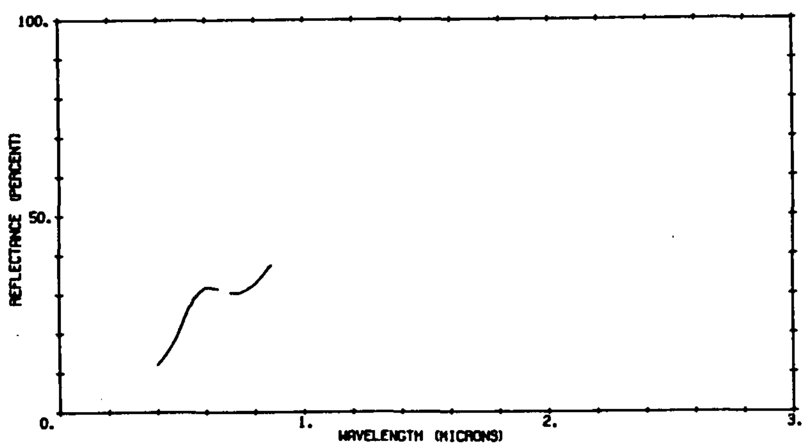
B03995 258

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=0 DEGREES,
ANG.=75 DEGREES



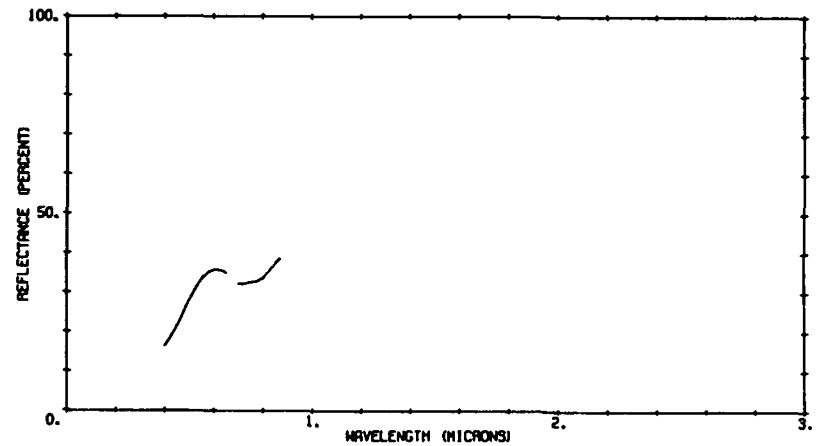
B03995 259

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=90 DEGREES,
ANG.=30 DEGREES



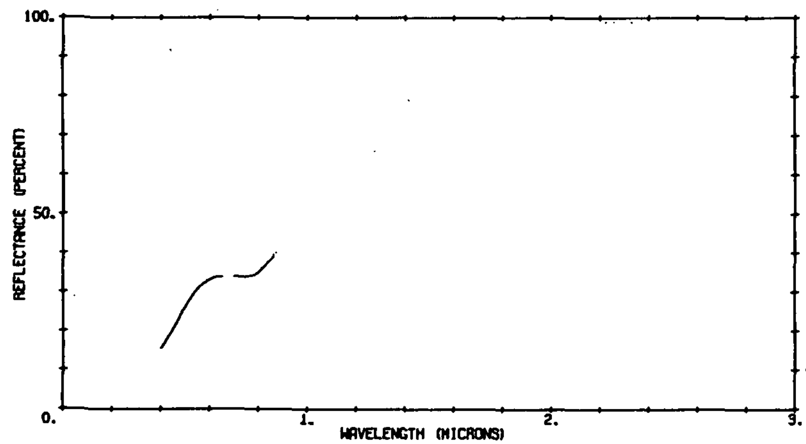
B03995 260

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=90 DEGREES,
ANG.=60 DEGREES



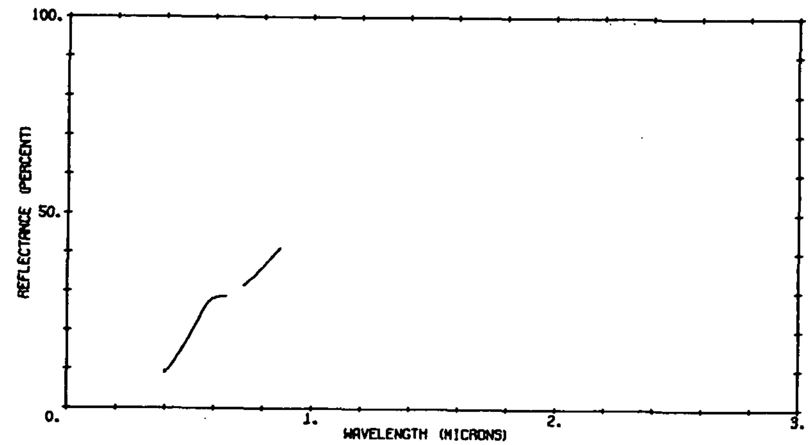
B03995 261

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=90 DEGREES, ANG.=75 DEGREES



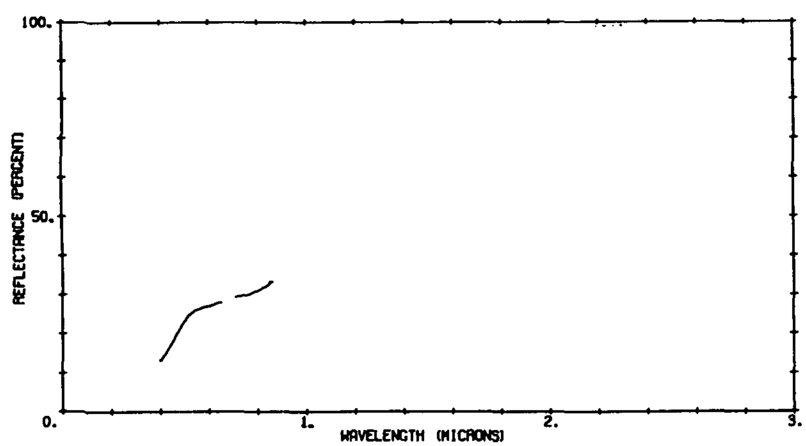
B03995 262

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=180 DEGREES, ANG.=330 DEGREES



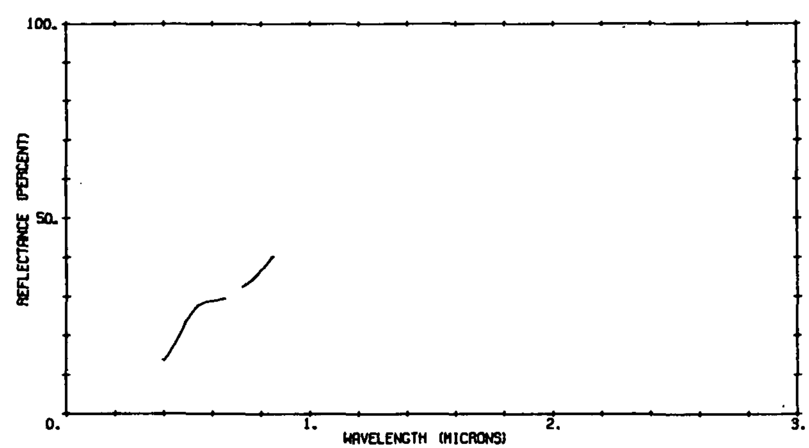
B03995 263

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=180 DEGREES, ANG.=60 DEGREES



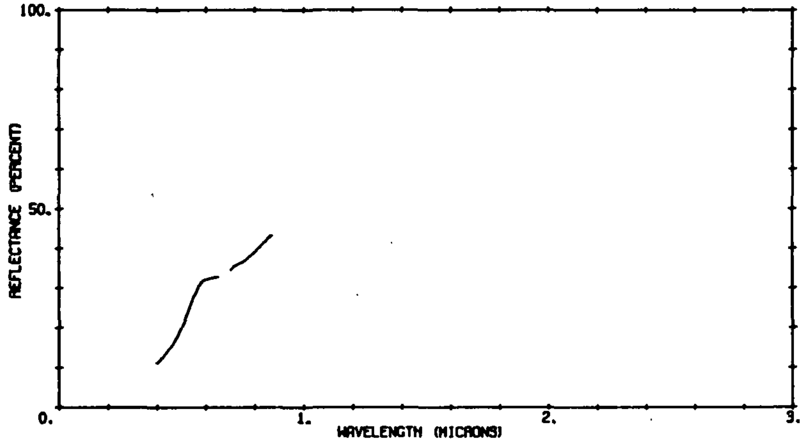
B03995 264

SAND DUNE, HEAVY EXPRESSED MICRORELIEF,DRY,A=180DEG.ANG=750.



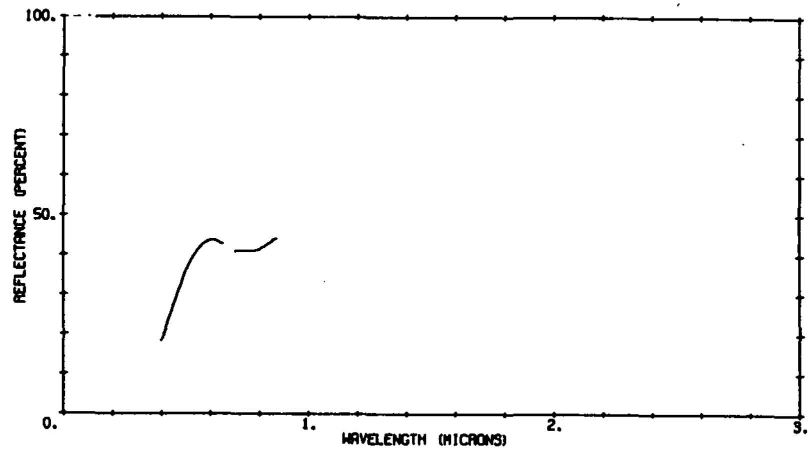
B03995 265

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=270 DEGREES, ANG.=30 DEGREES



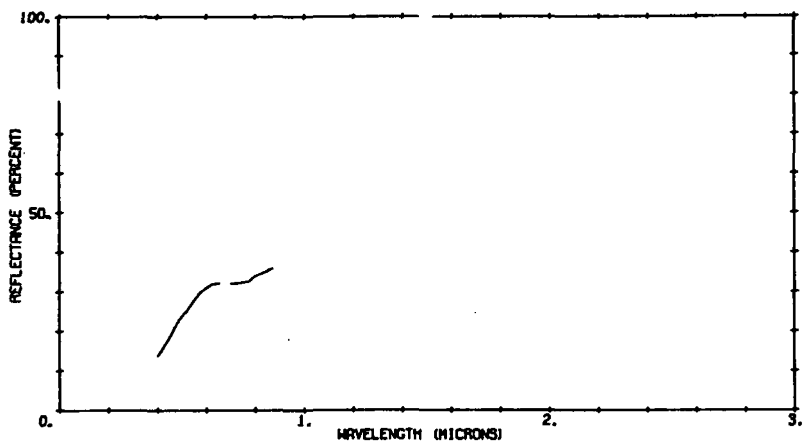
B03995 266

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=270 DEGREES, ANG.=60 DEGREES



B03995 267

SAND DUNE, HEAVY EXPRESSED MICRORELIEF, DRY, A=270 DEGREES, ANG.=75 DEGREES



(F)BFDA

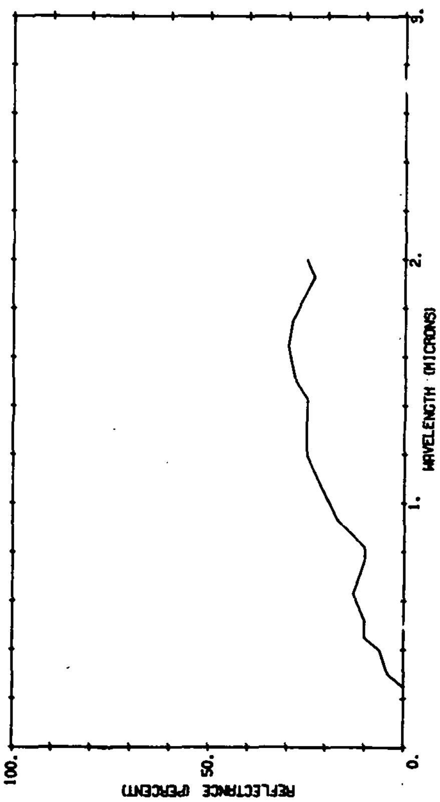
SOIL

Sandy Loam

368

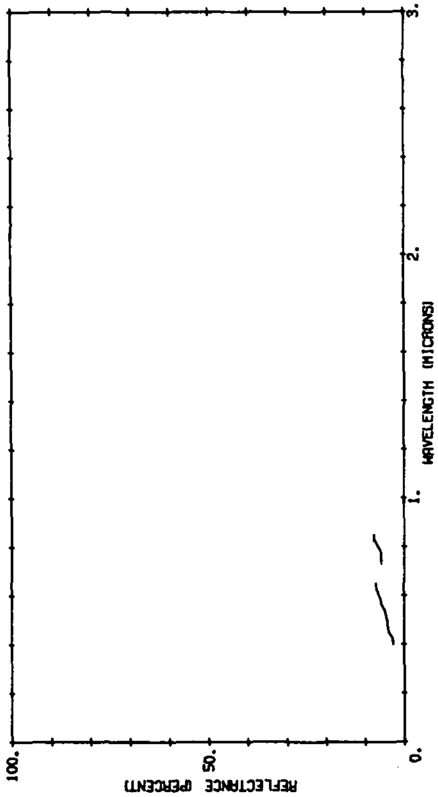
B01337 031

GOLD SANDY LOAM



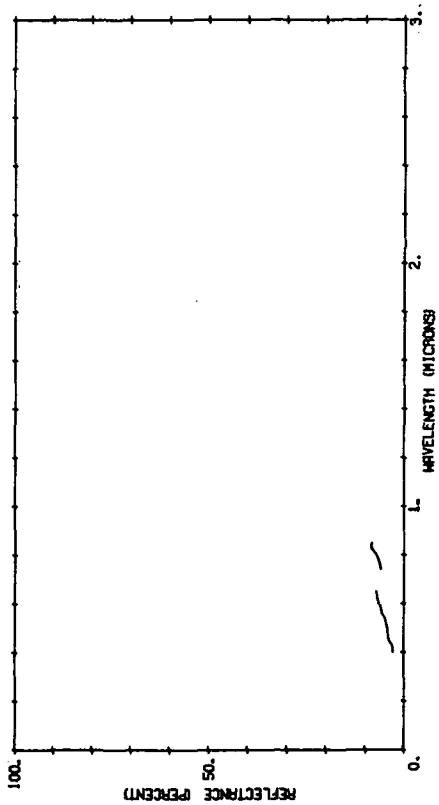
B03995 290

SOIL, SANDY LOAM, PLOUGHED, MOIST, CLOUDY SKY, NORMAL



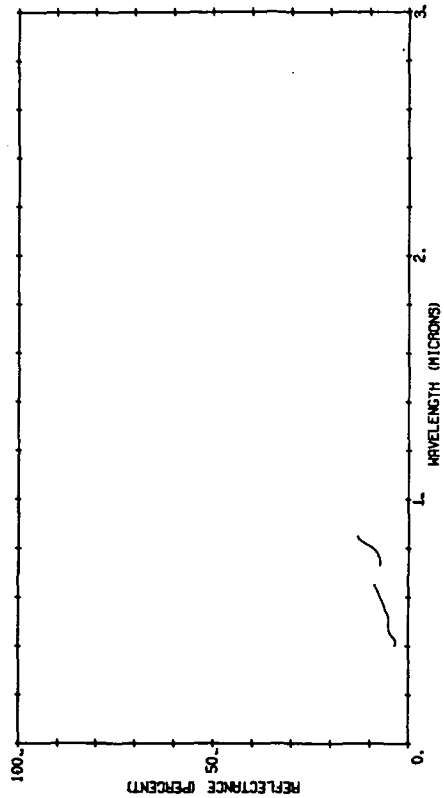
B03995 291

SOIL, SANDY LOAM, PLOUGHED, MOIST, CLOUDY SKY, ANG.=15 DEGR
EES



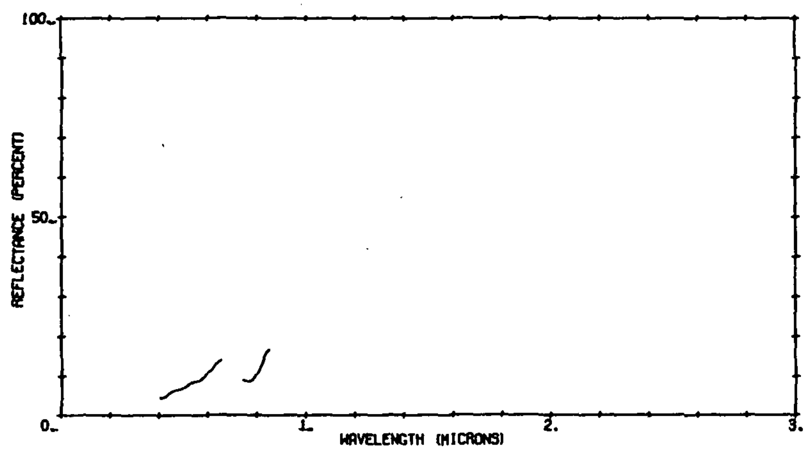
B03995 292

SOIL, SANDY LOAM, PLOUGHED, MOIST, CLOUDY SKY, ANG.=30 DEGR
EES



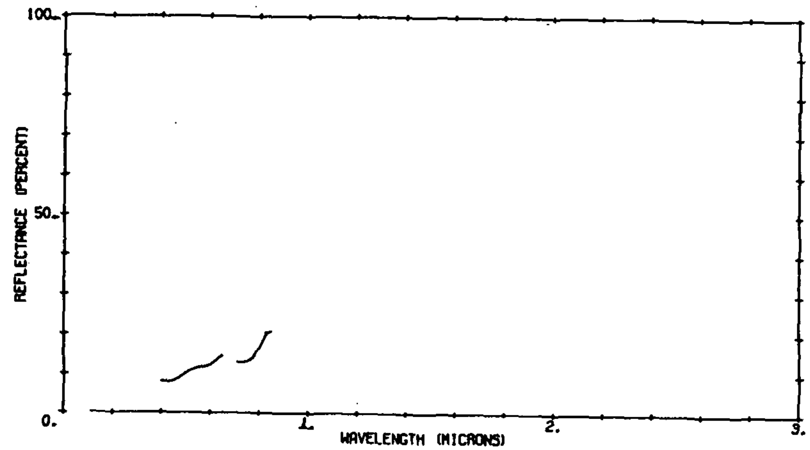
B03995 293

SOIL, SANDY LOAM, PLOUGHED, MOIST, CLOUDY SKY, ANG.=45 DEGREES



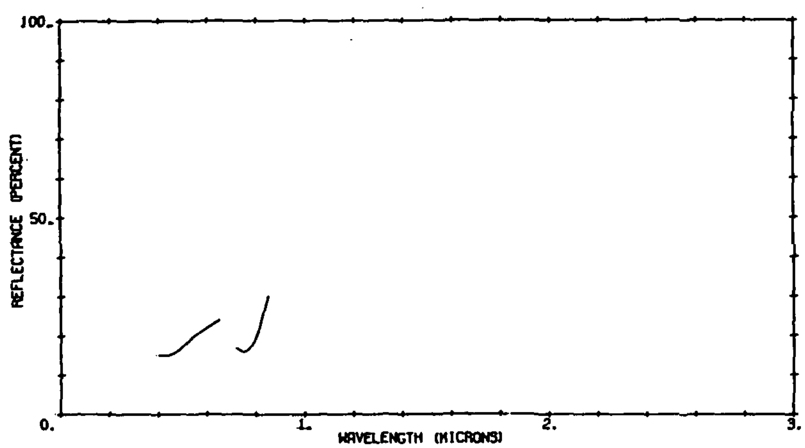
B03995 294

SOIL, SANDY LOAM, PLOUGHED, MOIST, CLOUDY SKY, ANG.=60 DEGREES



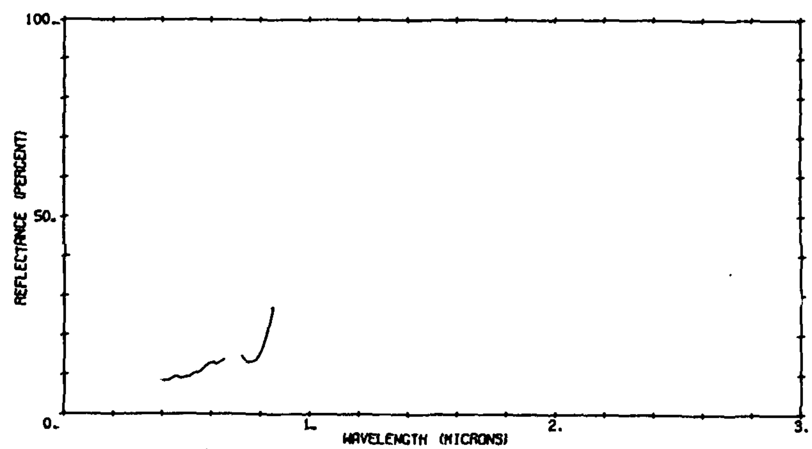
B03995 295

SOIL, SANDY LOAM, PLOUGHED, MOIST, A=. DEGREES, ANG.=45 DEGREES



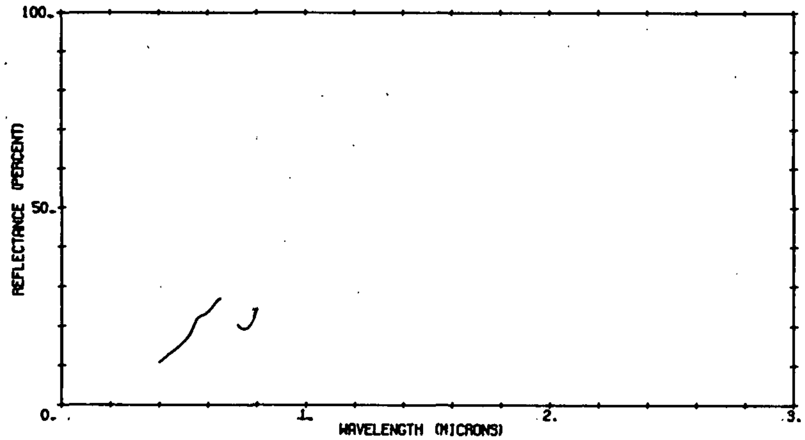
B03995 296

SOIL, SANDY LOAM, PLOUGHED, MOIST, A=90 DEGREES,ANG.=45 DEGREES



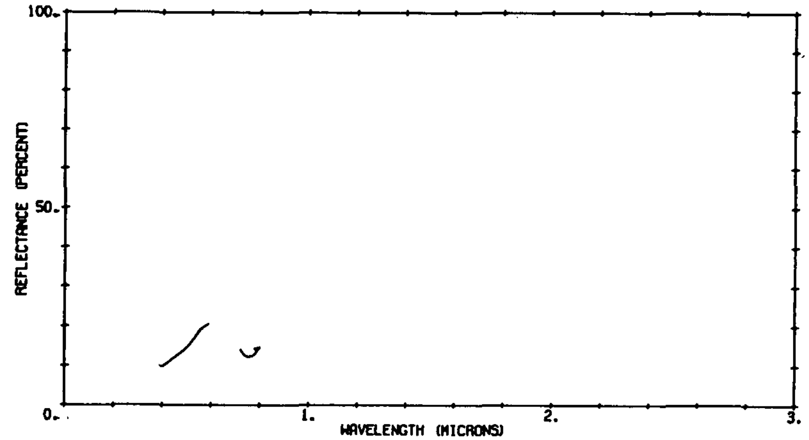
B03995 297

SOIL, SANDY LOAM, PLOUGHED, MOIST, A=18[illegible] DEGREES, ANG.=4
5 DEGREES



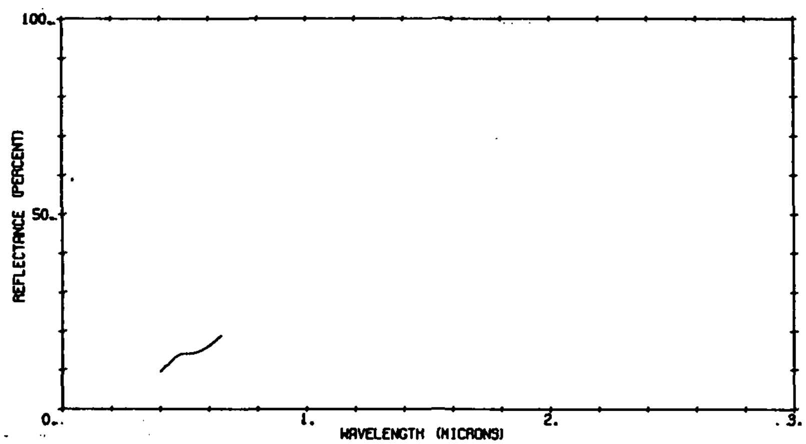
B03995 298

SOIL, SANDY LOAM, PLOUGHED, MOIST, A=27[illegible] DEGREES, ANG.=4
5 DEGREES



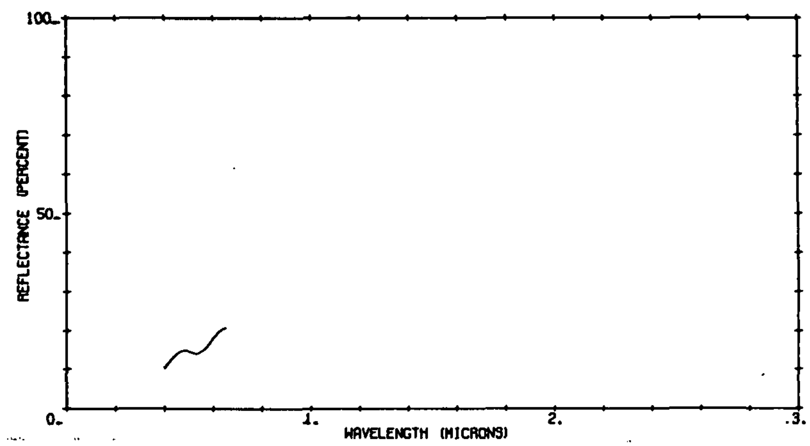
B03995 299

SOIL, SANDY LOAM, PLOUGHED, DRY, NORMAL FOREST STEPPE



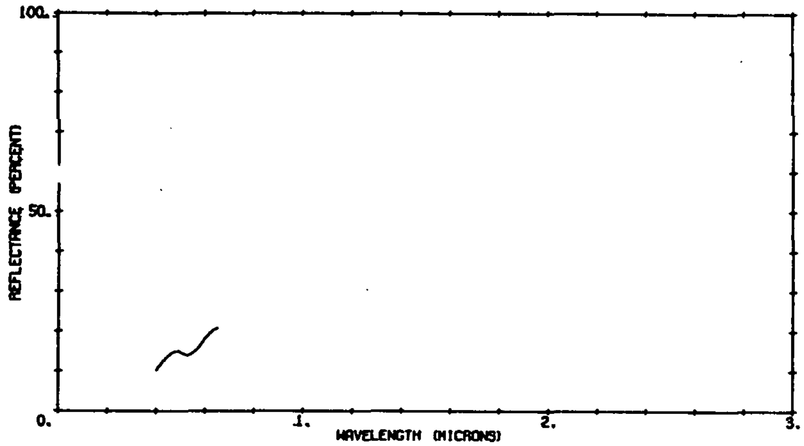
B03995 300

SOIL, SANDY LOAM, PLOUGHED, DRY, A=[illegible] DEGREES, ANG.=45 DEGR
EES



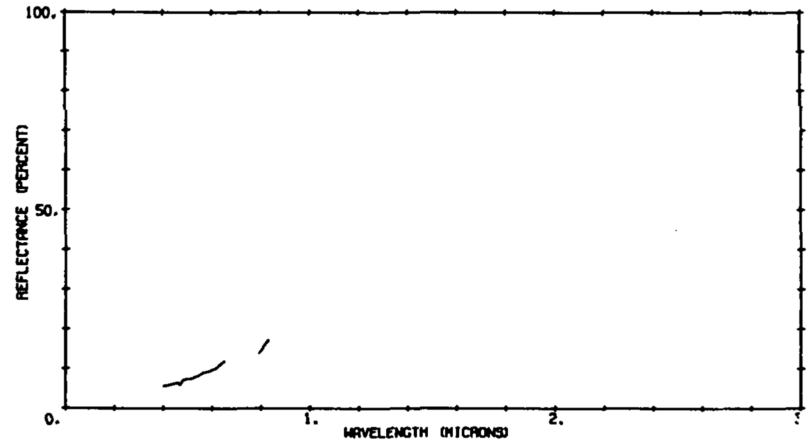
B03995 301

SOIL, SANDY LOAM, PLOUGHED, DRY, A=90 DEGREES, ANG.=45 DEGR
EES



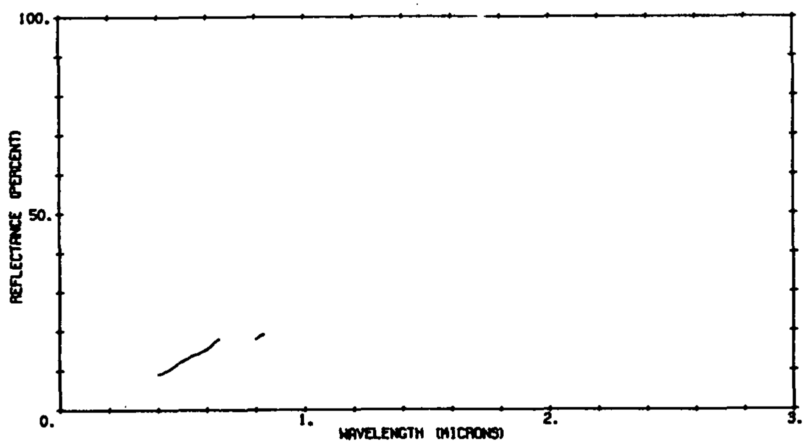
B03995 320

EARTH ROAD, TRAMPLED, SAND LOAM, NORMAL FOREST STEPPE



B03995 321

EARTH ROAD, TRAMPLED, SAND LOAM, CLOUDY SK ANG.=3 DEGREES



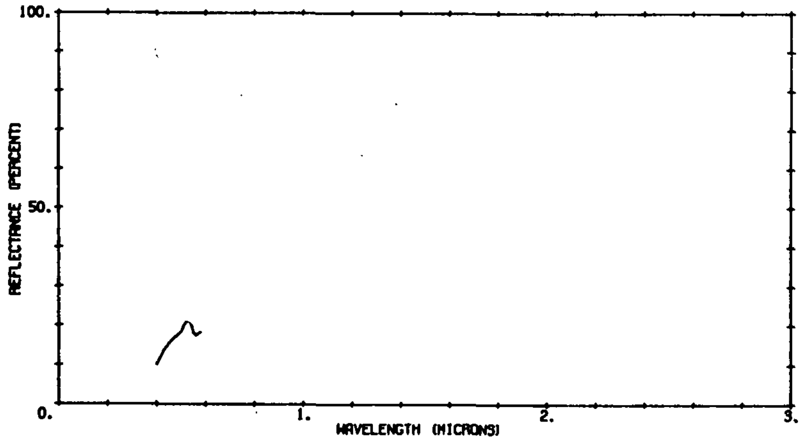
(F)BFHB

SOIL

Gravel (less than 3-in. diameter)

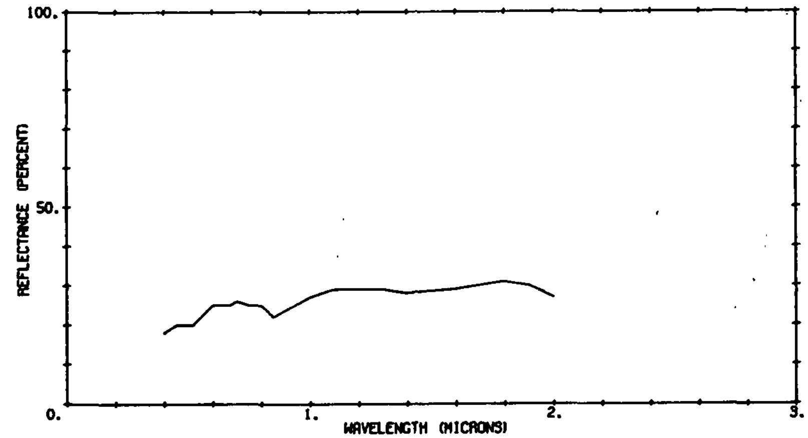
B03995 355

STONES, GATHERED IN A PILE, DRY, A=90 DEGREES, ANG=45 DEGREES, N.F.H.



B01337 038

GRAVEL



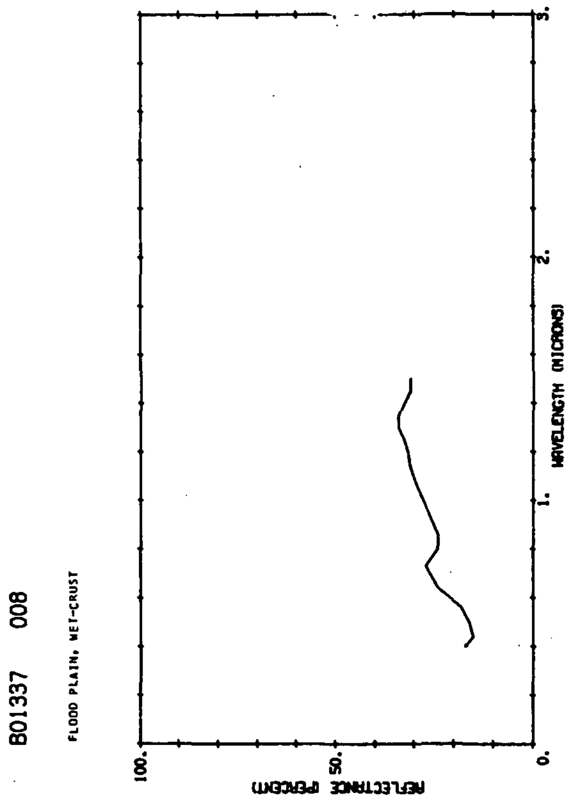
(F)BFHB 1

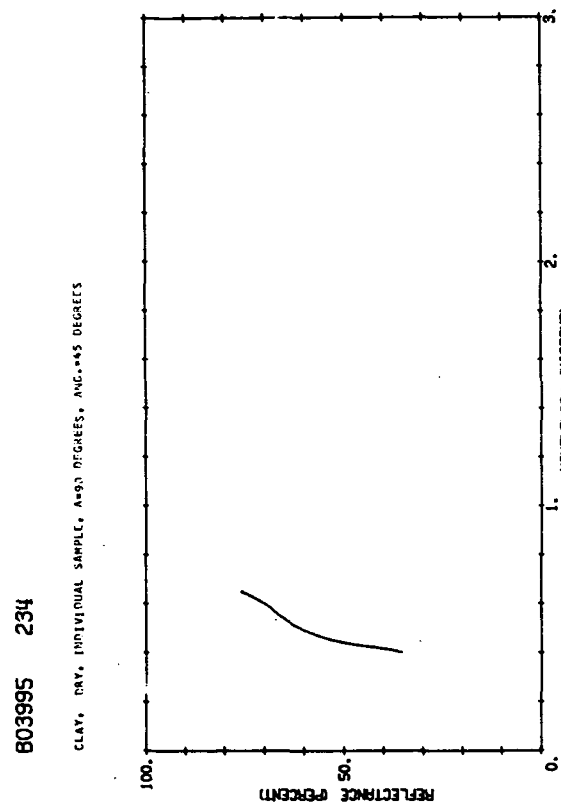
(F)BFGC

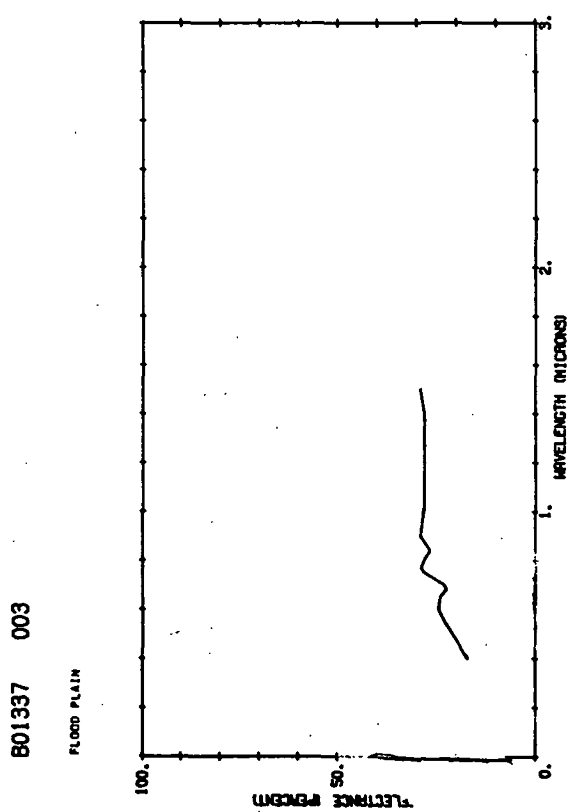
SOIL

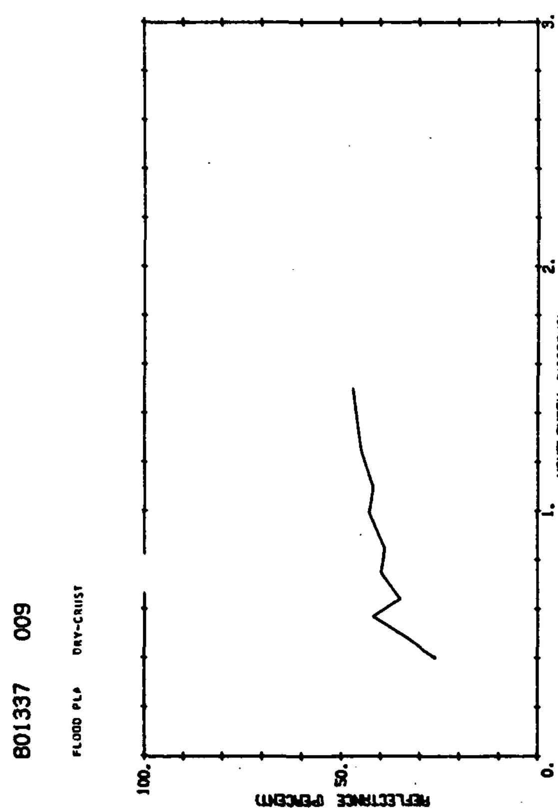
Clay

375


B01337 008
FLOOD PLAIN, WET-CRUST
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B03995 234
CLAY, DRY, INDIVIDUAL SAMPLE, A=90 DEGREES, ANG.=45 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B01337 003
FLOOD PLAIN
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B01337 009
FLOOD PLA DRY-CRUST
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

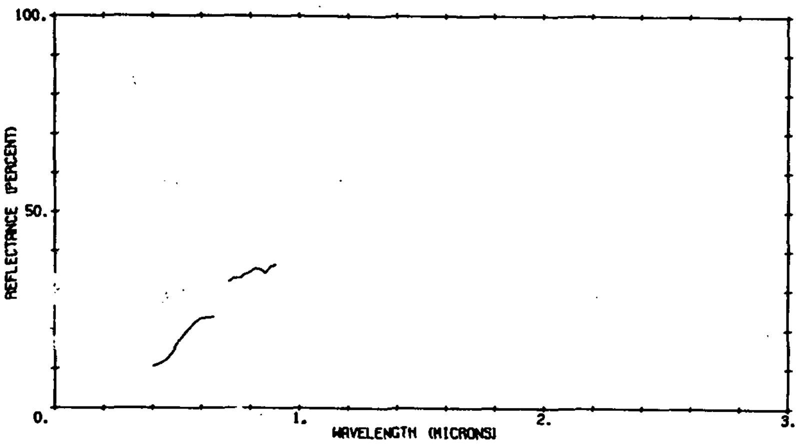
(F)BFHC

SOIL

Cobbles (3- to 10-in. diameter)

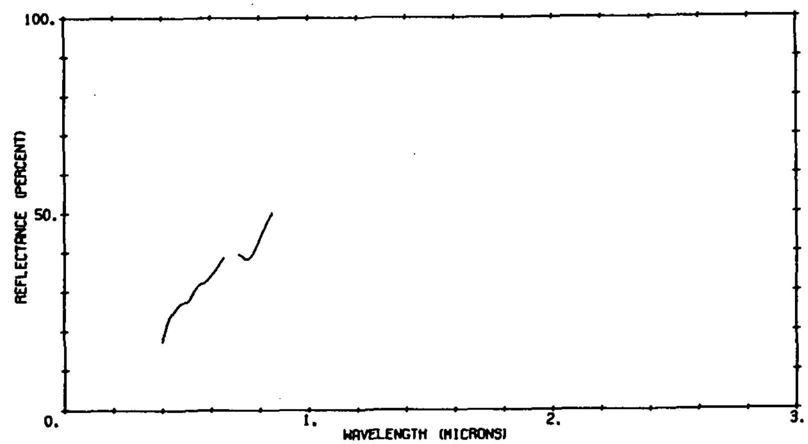
B03995 329

ROAD, PAVED COBBLESTONE, DRY, NORMAL TIPI-A



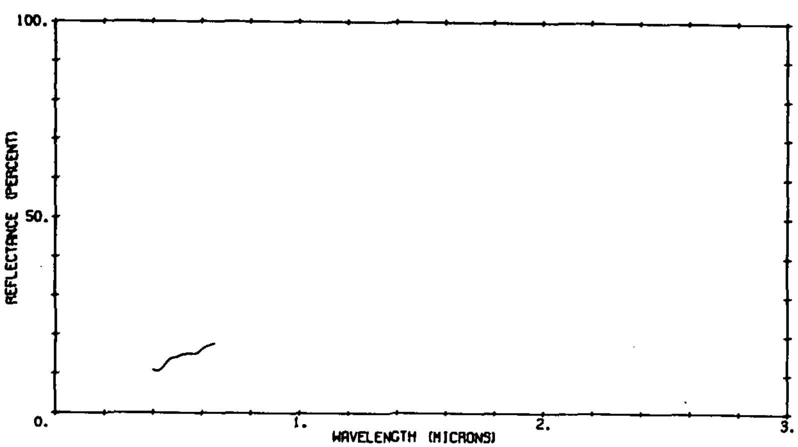
B03995 330

ROAD, PAVED COBBLESTONE, DRY, NORMAL N.F.B.



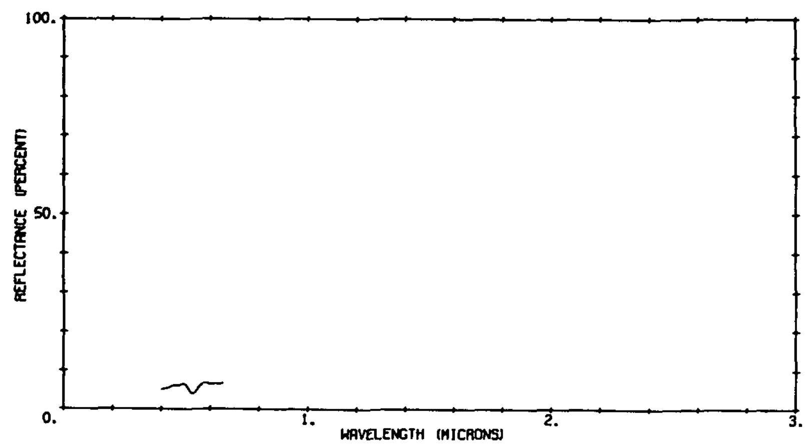
B03995 331

ROAD, PAVED COBBLESTONE, DRY, A=90 DEGREES, ANG.=45 DEGR
EES, N.F.B.



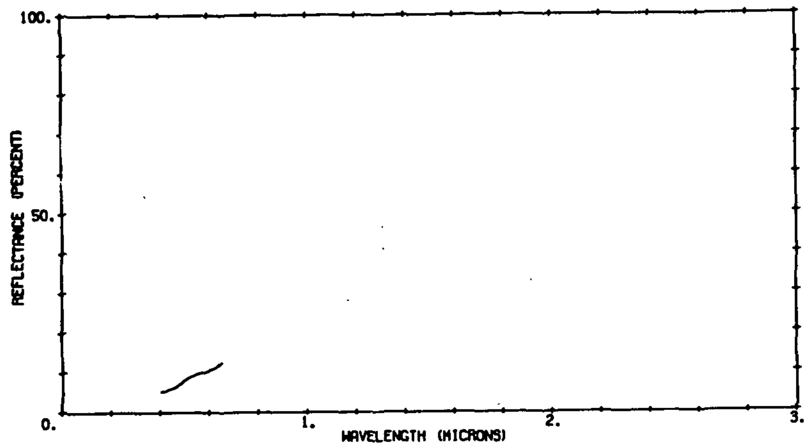
B03995 332

ROAD, PAVED COBBLESTONE, WET, A=90 DEGREES, ANG.=45 DEGR
EES, N.F.B.



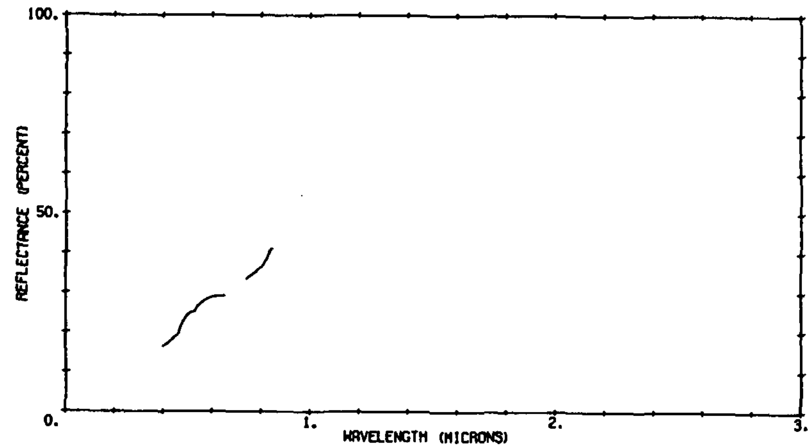
B03995 362

STREET, COBBLESTONE, IN CITY, WET, A=90 DEGREES,ANG.=45 DEGR
EES, N.F.B.



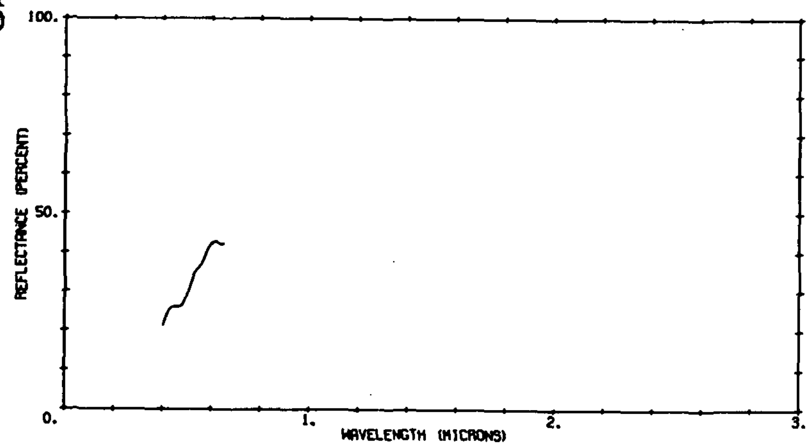
B03995 363

STREET, COBBLESTONE, IN CITY, DRY, A=90 DEGREES,ANG.=45 DEGR
EES, N.F.H.



B03995 369

SIDEWALK, FLAGSTONE, IN CITY, DRY, A=90 DEGREES,ANG.=45 DEGR
EES, N.F.B.



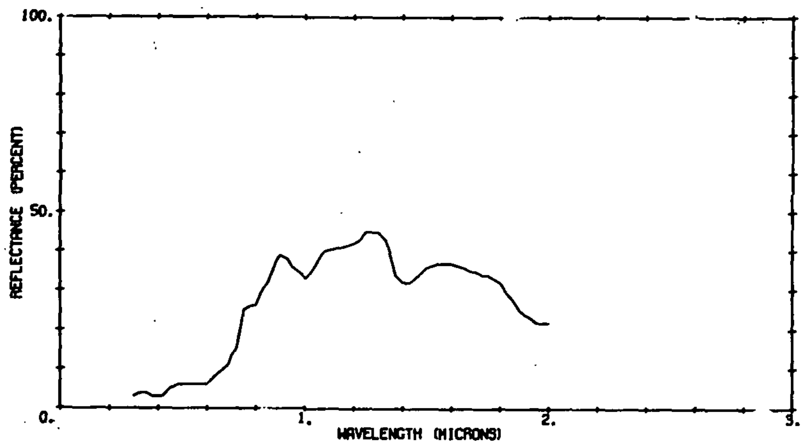
(F)BG

VEGETATION

380

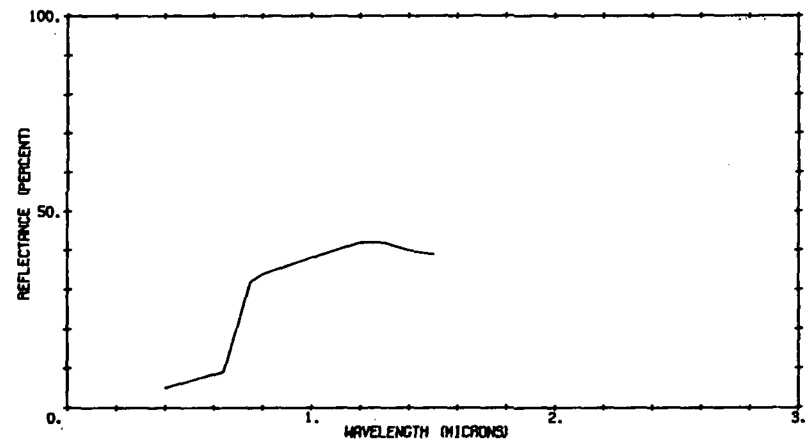
B01337 001

DRY MAT FIRE BURN



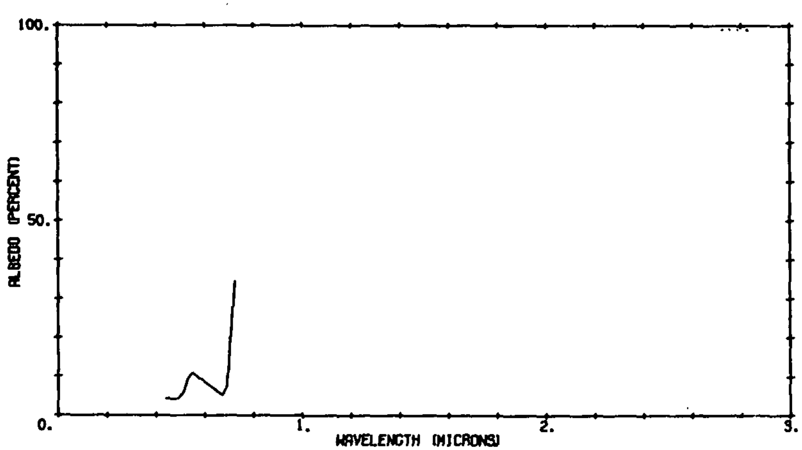
B01337 002

FIRE BURN MOSS



B01370 006

VEGETATION, YELLOWISH-GREEN (ORLANDO, FLL



B01370 007

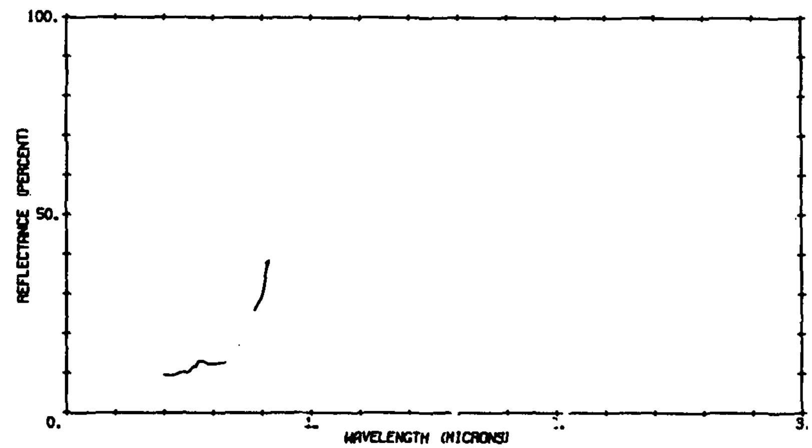
GREEN GROWTH ON LAKE (ORLANDO, FLORIDA)

B01370 008

GREEN GROWTH ON LAKE (ORLANDO, FLORIDA)

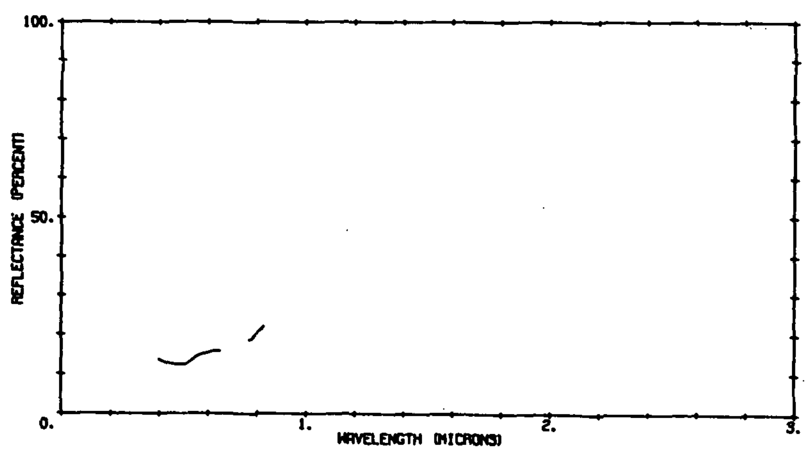
B03995 043

HALOXYLON, MATURE TREES, LATE SUMMER GREEN



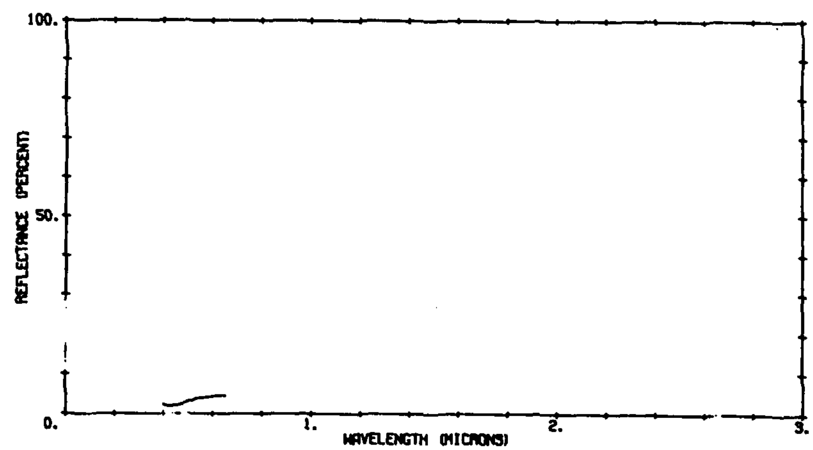
B03995 044

HALOXYLON, MATURE TREES, DRY



B03995 050

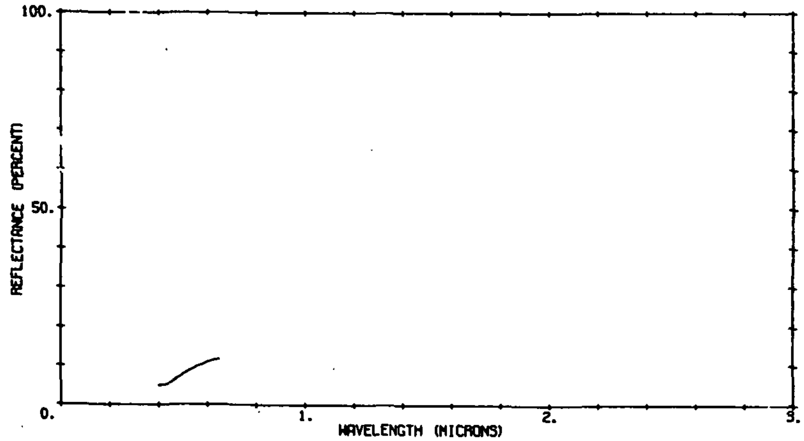
WEEDS, DENSE GROWTH, DRYING AND BROWNISH EARLY AUTUMN



(F)BG 2

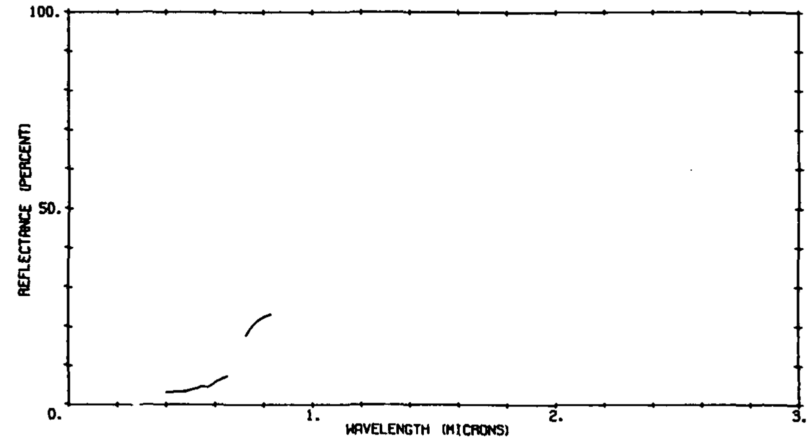
B03995 051

WEEDS, DENSE GROWTH, DRYING AND BROWNISH EARLY AUTUMN NORMAL
ANG.=30 DEGREES



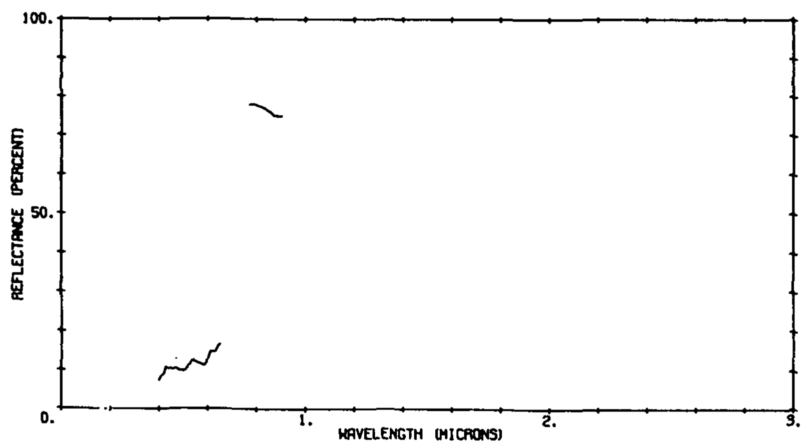
B03995 052

WEEDS, DENSE GROWTH, DRYING AND BROWNISH (EARLY AUTUMN)
A=90 DEGREES, ANG.= 45 DEGREESA=90DEGREES, ANG.= 45 DEGREES



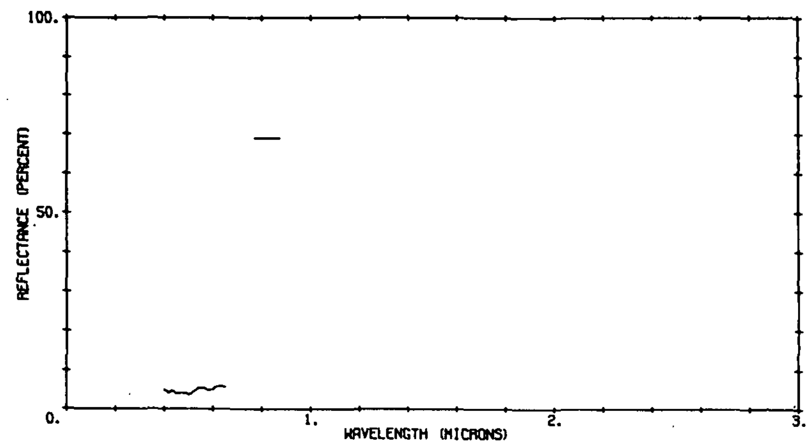
B03995 055

WILLOW HERB, DENSE GROWTH, IN FLOWERING PERIOD A=90 DEGREES
ANG.=45 DEGREES



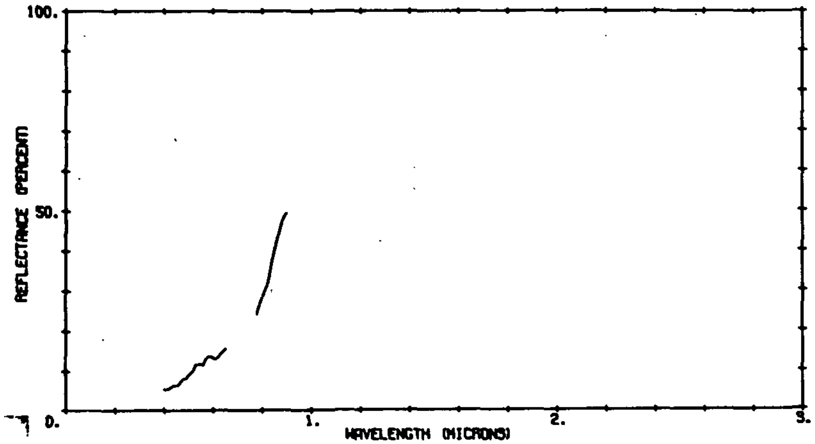
B03995 165

YANTAK (CAMEL GRASS) ROAD SIDE, HEAVILY DUST . . NORMAL



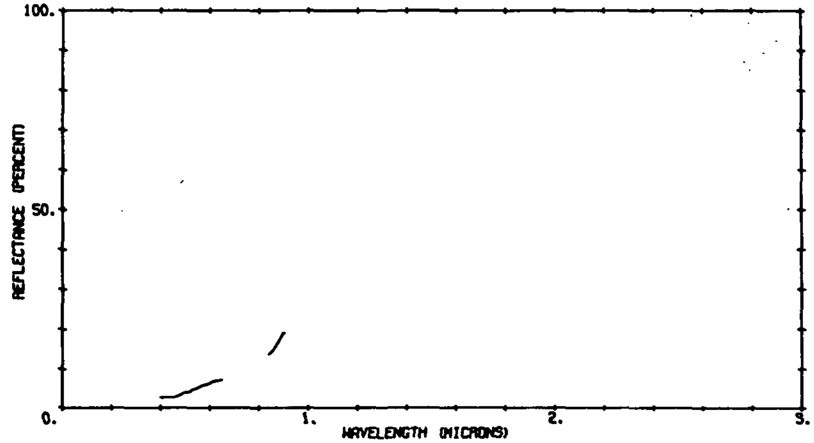
B03995 168

HAY, IN STACK, DRY, A=110DEGREES



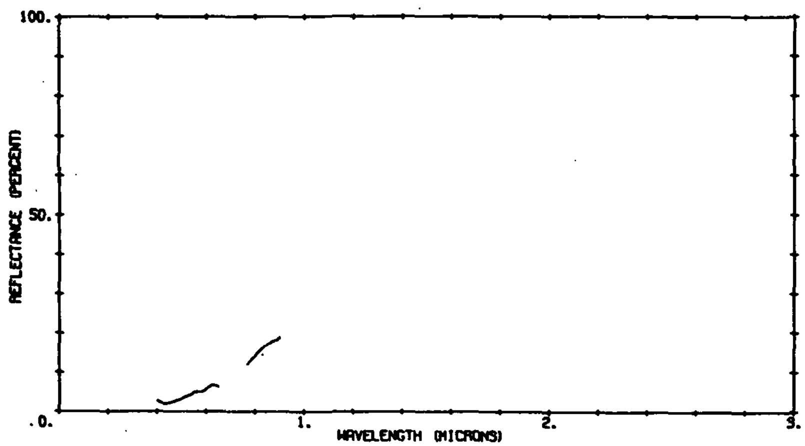
B03995 169

LICHENS, GREENISH BROWN ON ROADSIDES AND FOOT PATHS OVER TURF, DRY, NORMAL



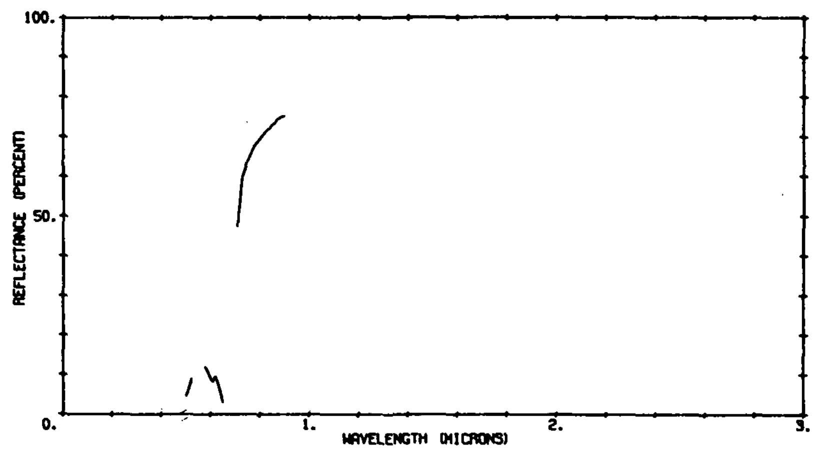
B03995 170

MOSS, REDDISH BROWN, WET, NORMAL



B03995 171

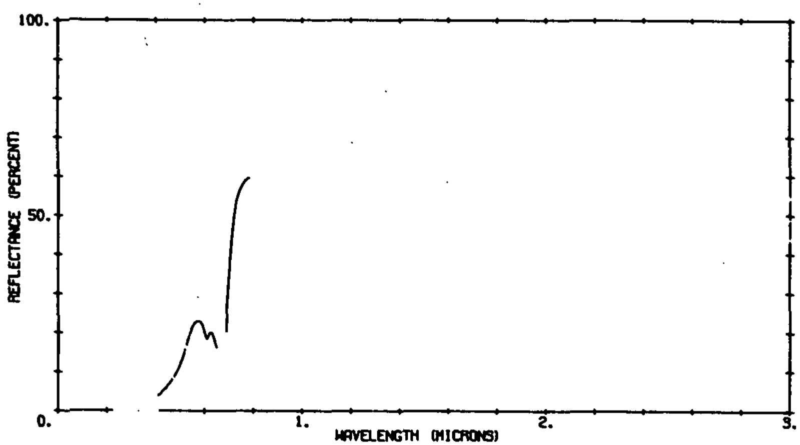
SPHAGNUM MOSS, IN MARSHY LOWLAND, WET, NORMAL



(F)BG 5

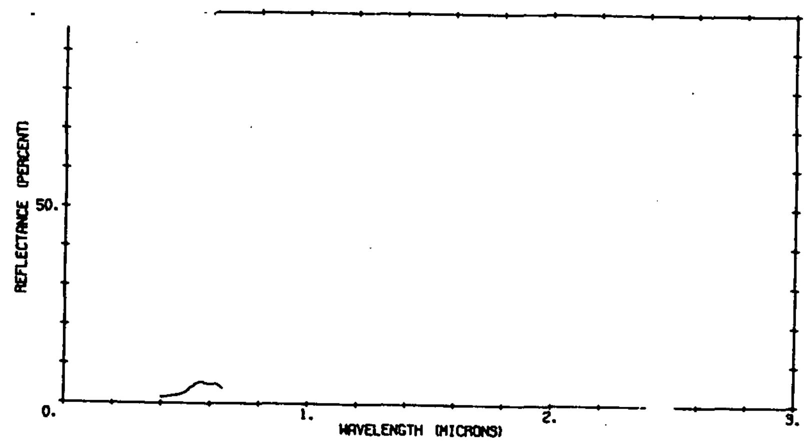
B03995 172

SPHAGNUM MOSS, IN MARSHY LOWLAND, ON BANK OF BOG, DRY NORMAL



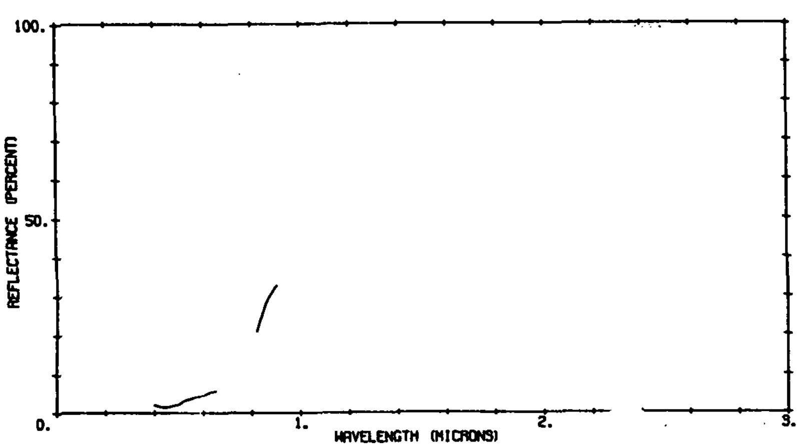
B03995 173

MOSS ON ROCKS, DARK GREEN ON M OUTCR 'S, DRY, NORMAL



B03995 174

MOSS ON TURF, REDDISH BROWN, DRY, NORMAL

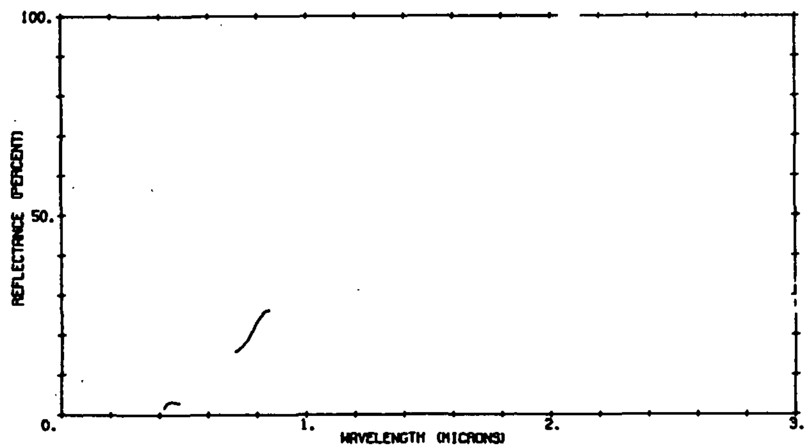


B03995 175

REINDEER MOSS, ON TURF, DRY, NORMAL

B03995 228

FIELD, WITH RIPE CROP, BUILDINGS AND ROADS, AIR ALT.=300M.



B03995 229

FIELD, WITH GREEN CROPS, FROM THE AIR, ALT.=300M.

(F)BG 6

(F)BGC

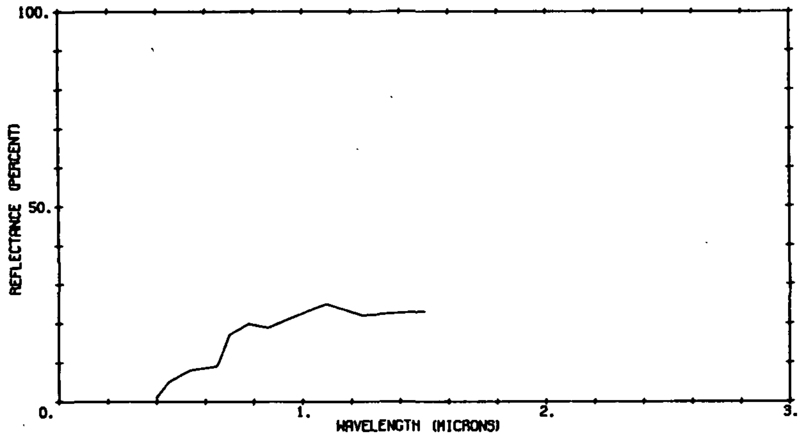
VEGETATION

Vascular

387

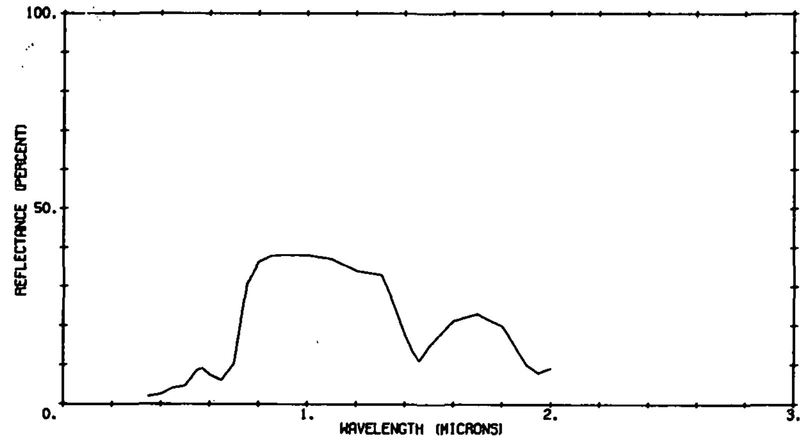
B01337 004

COTTON GRASS



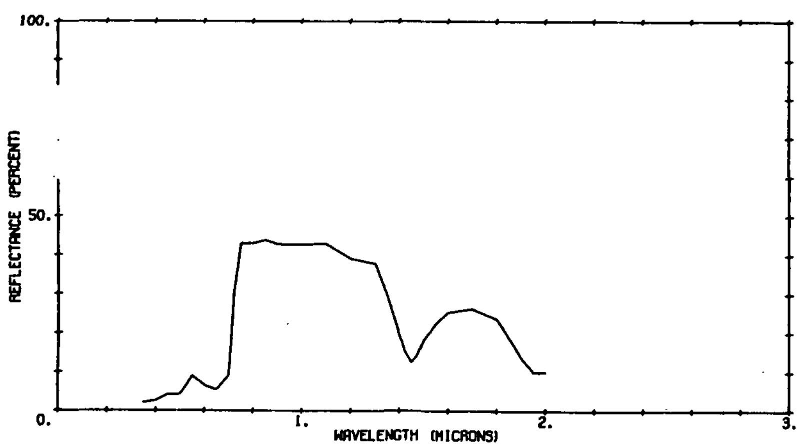
B01643 007

FOXTAIL, NORMAL STAND



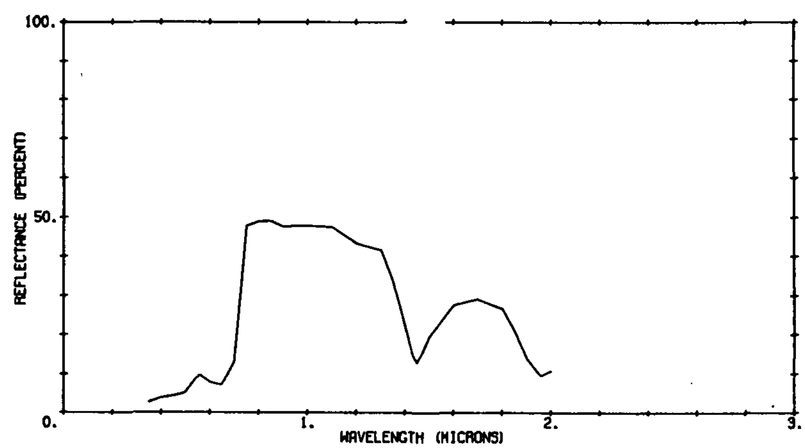
B01643 008

FOXTAIL, NORMAL STAND



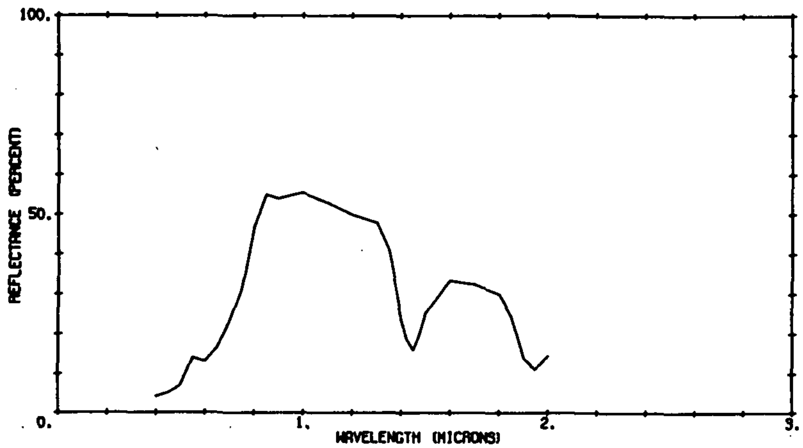
B01643 009

FOXTAIL, NORMAL STAND



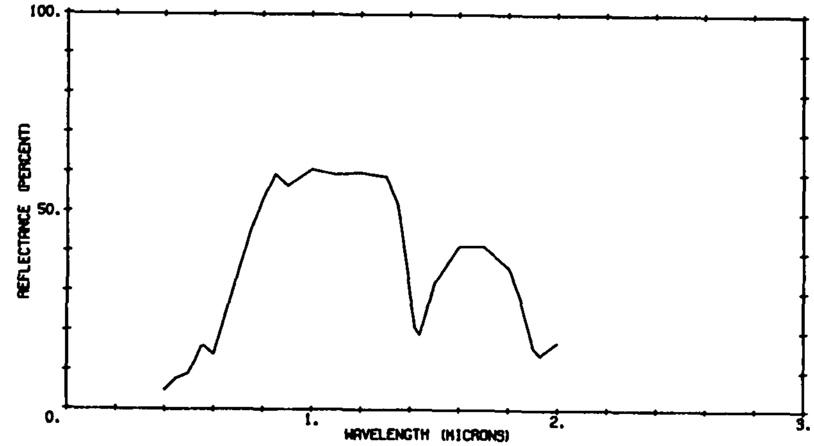
B01643 010

FOXTAIL, NORMAL STAND



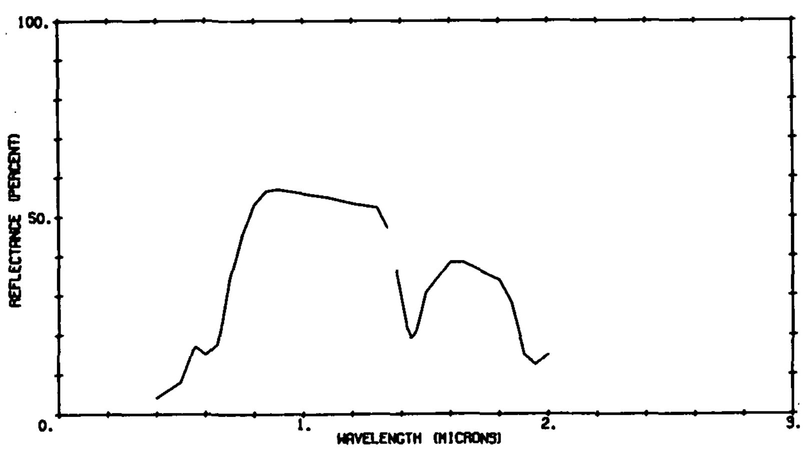
B01643 011

FOXTAIL, NORMAL STAND



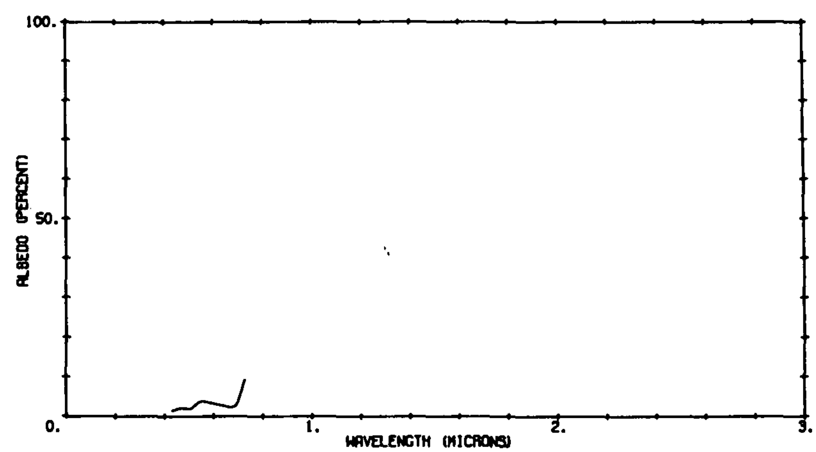
B01643 012

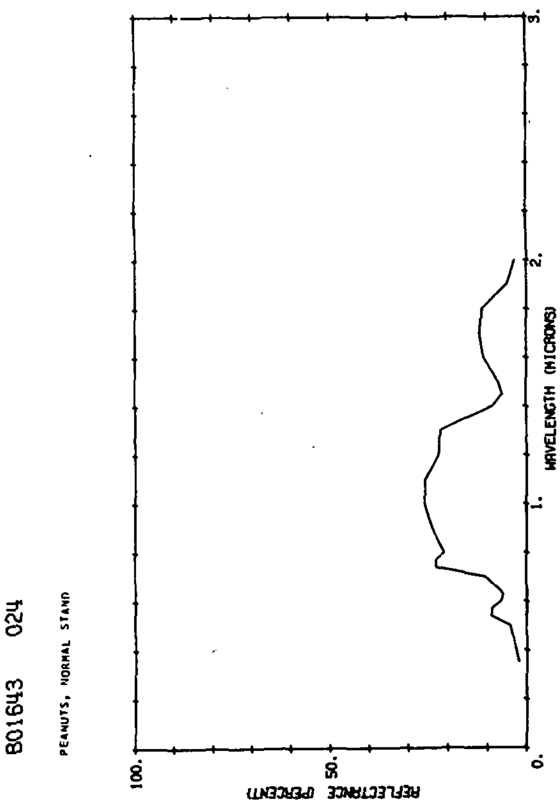
FOXTAIL, NORMAL STAND

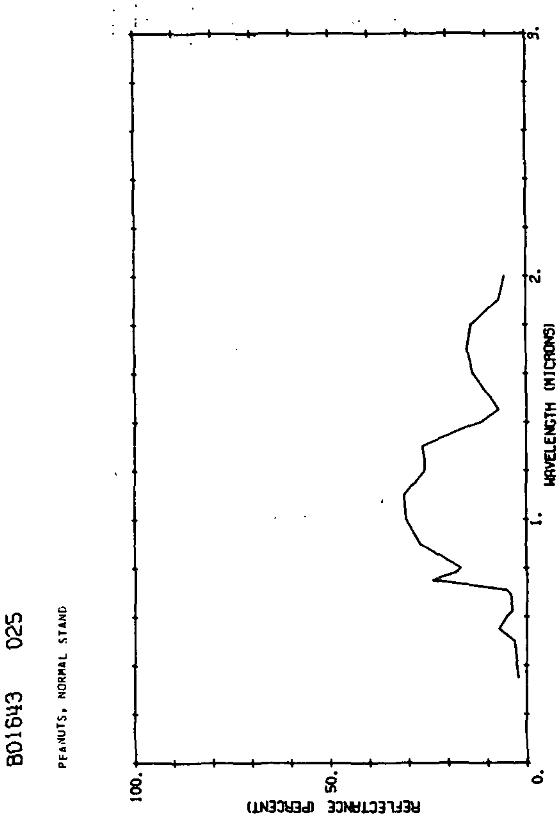


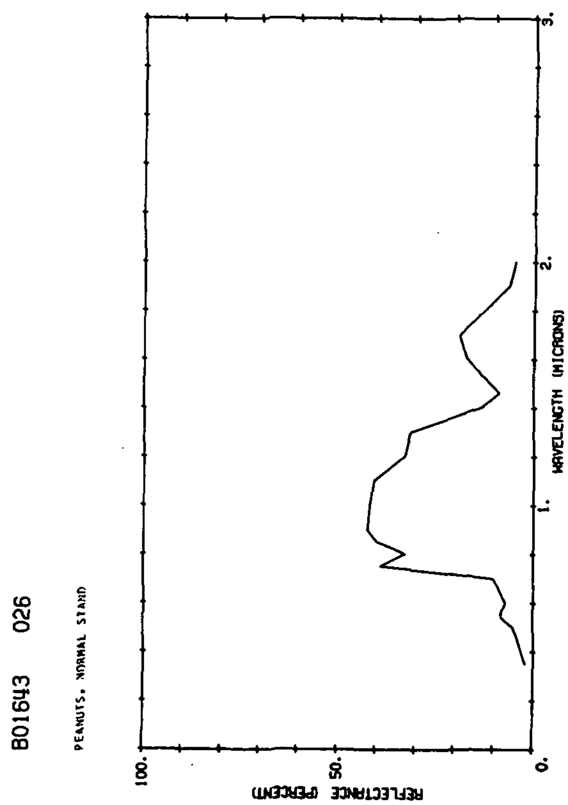
B01370 017

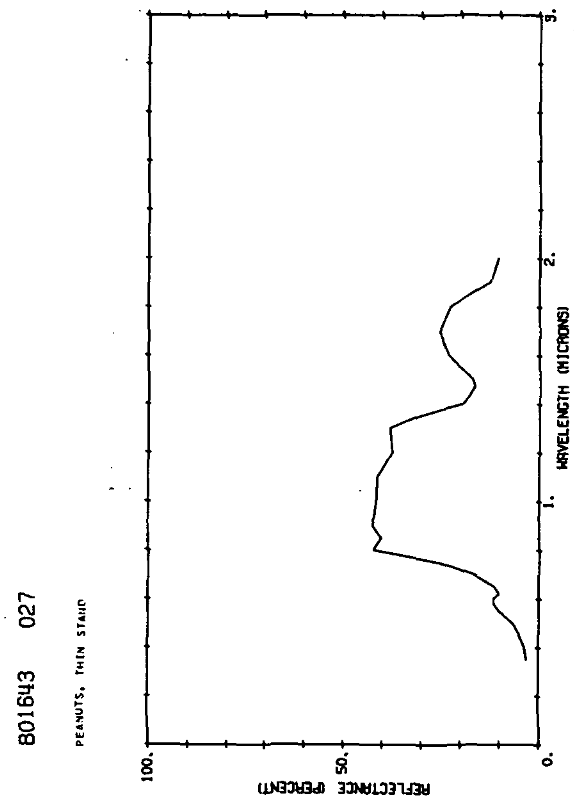
ORCHARD TREE (ORLANDO, FLORIDA)




B01643 024
PEANUTS, NORMAL STAND
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

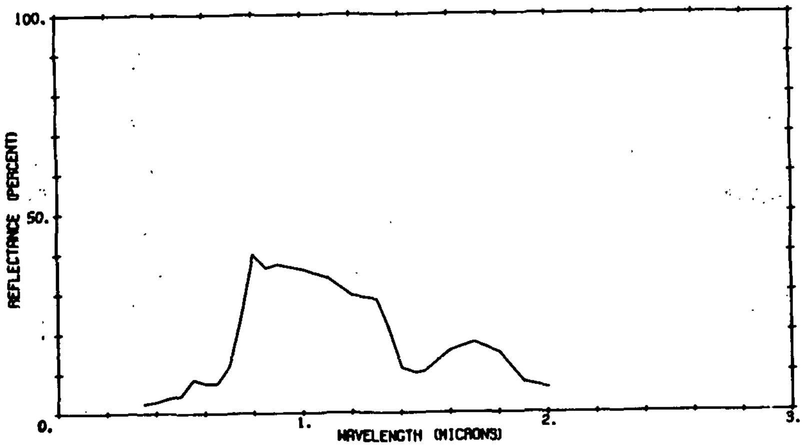

B01643 025
PEANUTS, NORMAL STAND
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B01643 026
PEANUTS, NORMAL STAND
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B01643 027
PEANUTS, THIN STAND
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

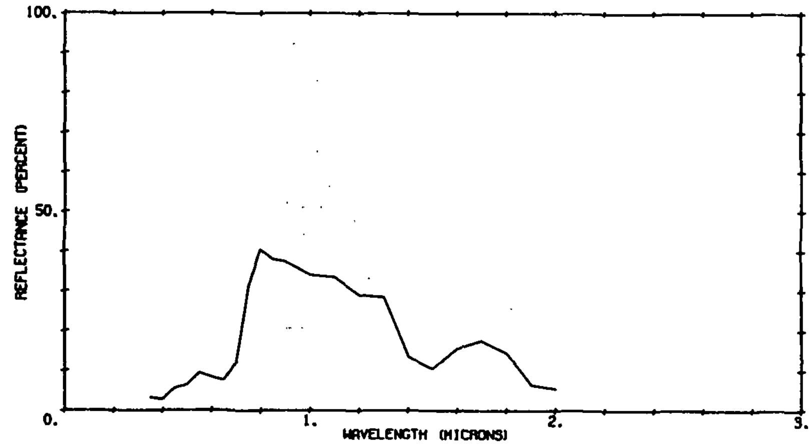
B01643 028

PEANUTS, THIN STAND



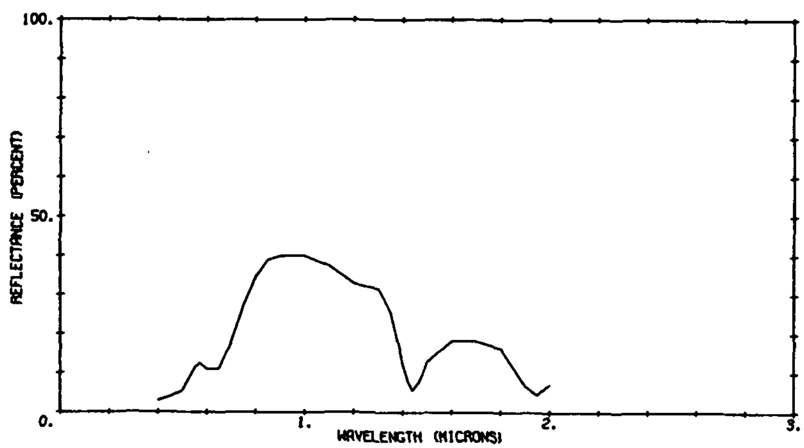
B01643 029

PEANUTS, THIN STAND



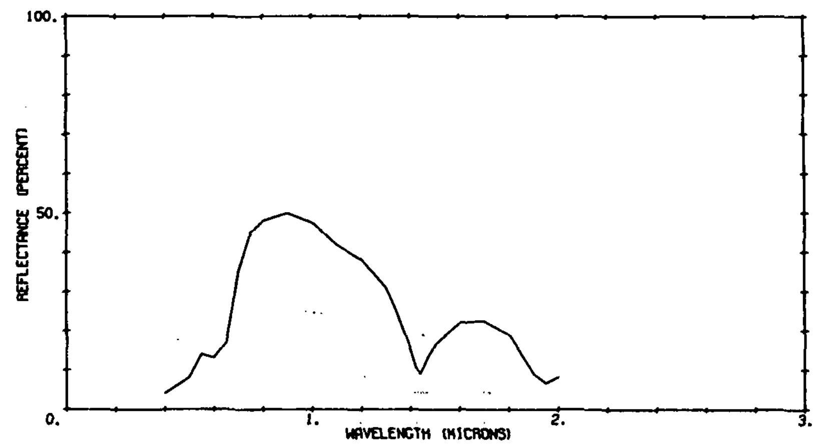
B01643 030

PEANUTS, NORMAL STAND



B01643 031

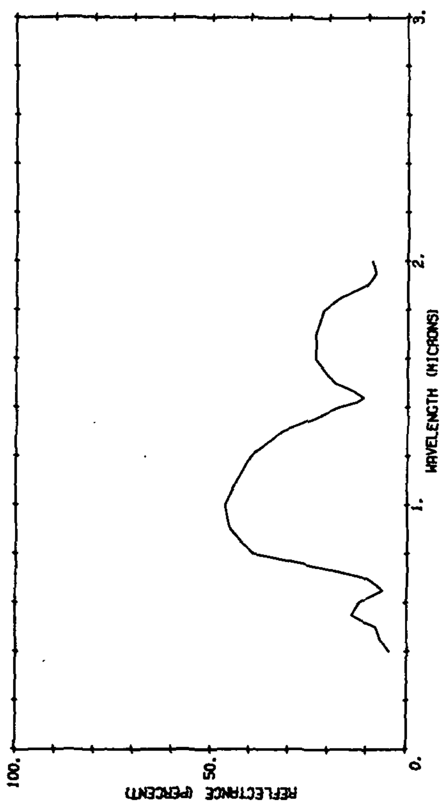
PEANUTS, NORMAL STAND



(F)BGC 4

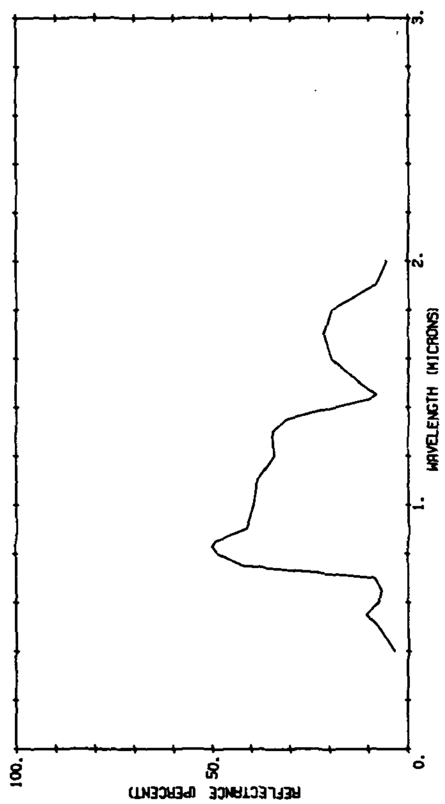
B01643 032

PEANUTS, NORMAL STAND



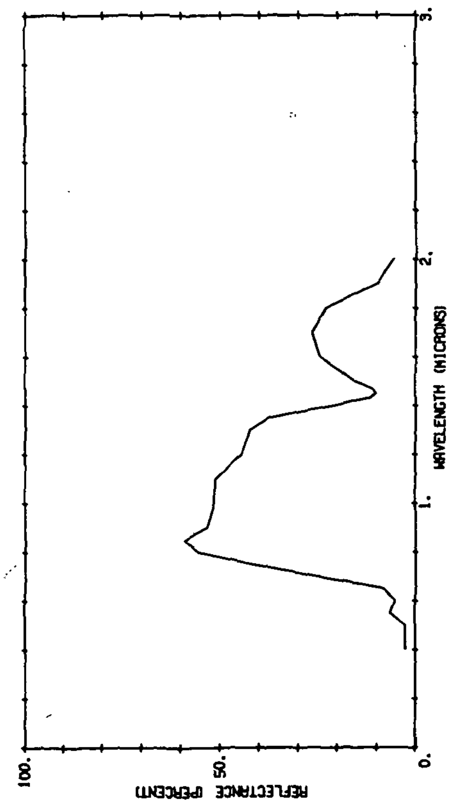
B01643 033

PIGWEED, NORMAL STAND



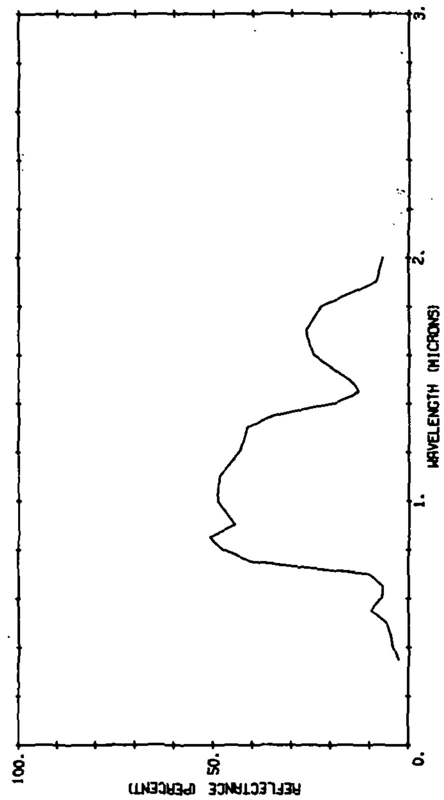
B01643 034

PIGWEED, NORMAL STAND



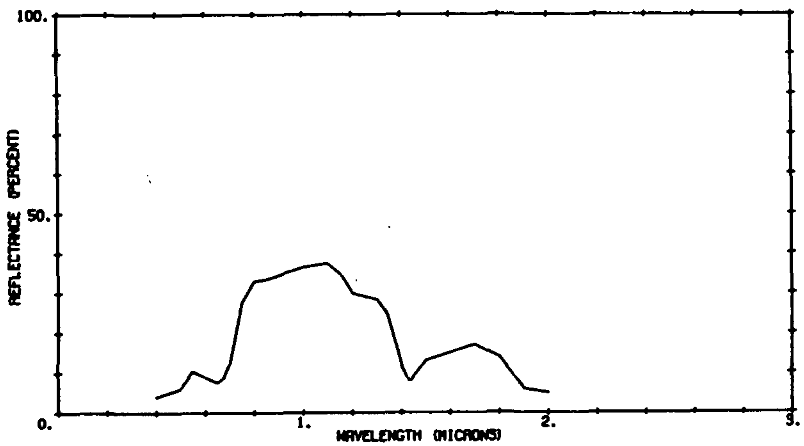
B01643 035

PIGWEED, NORMAL STAND



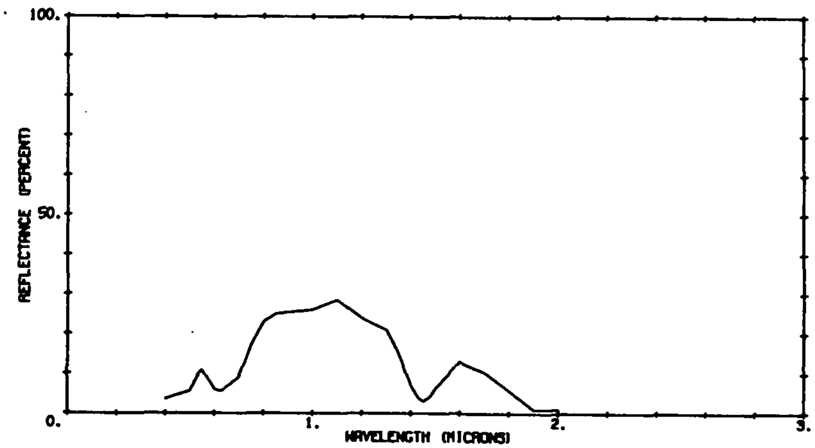
B01643 115

FLAX, NORMAL STAND



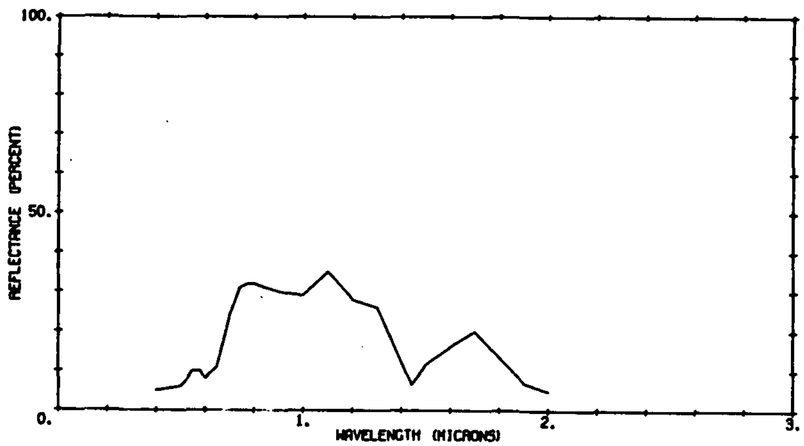
B01643 116

FLAX, NORMAL STAND



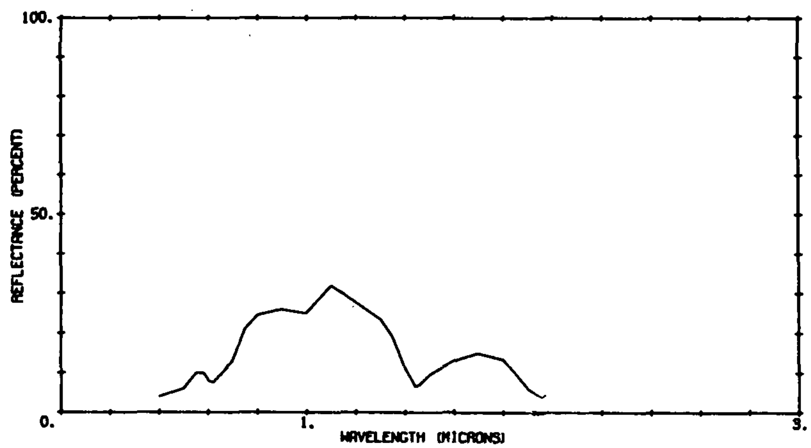
B01643 117

FLAX, NORMAL STAND



B01643 118

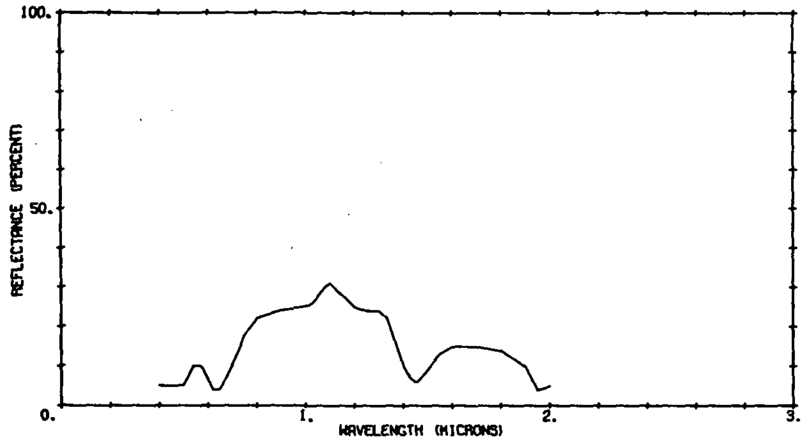
FLAX, NORMAL STAND



(F)BGC 6

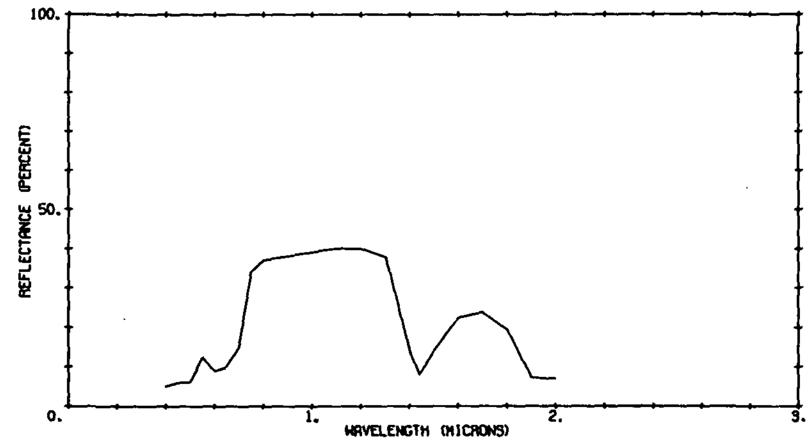
B01643 119

FLAX, NORMAL STAND



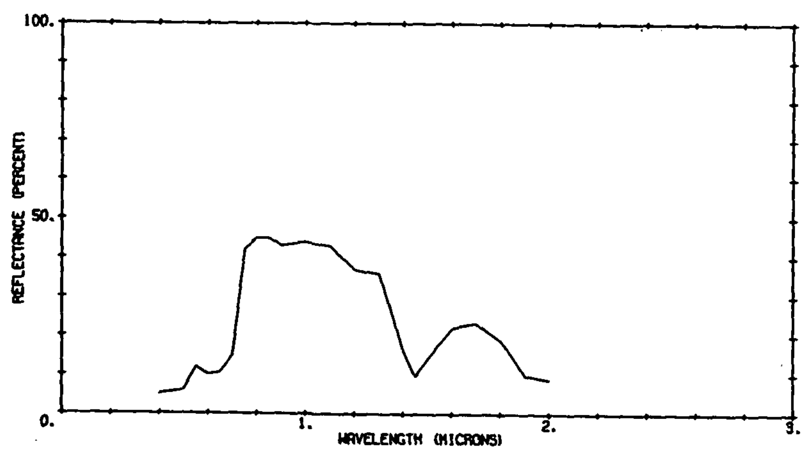
B01643 120

SUGAR BEETS, THIN STAND



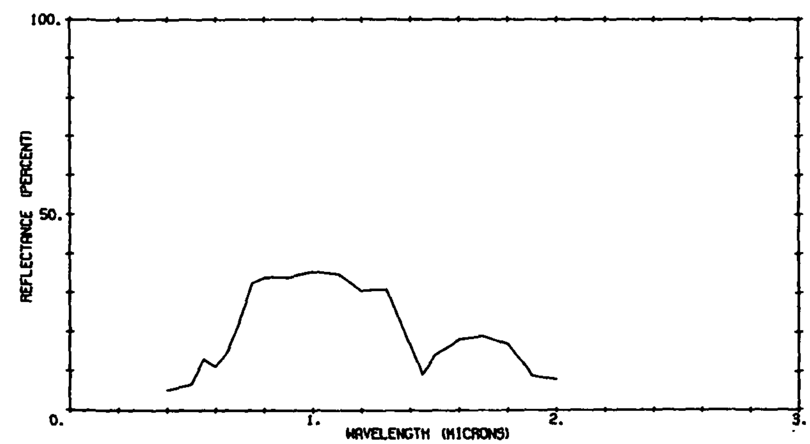
B01643 121

SUGAR BEETS, THIN STAND



B01643 122

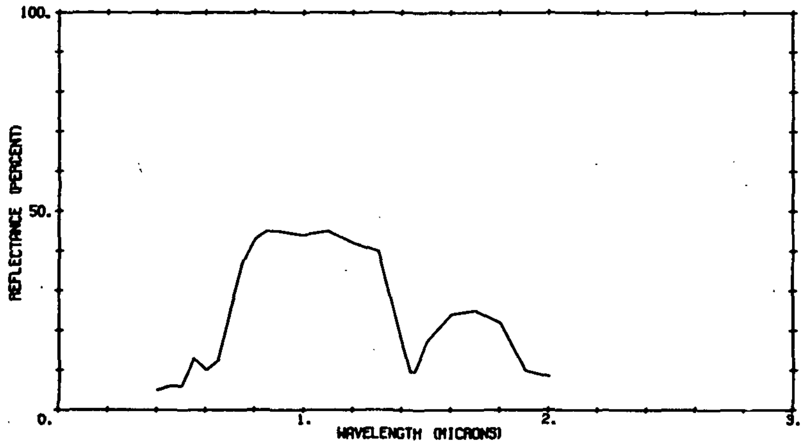
SUGAR BEETS, THIN STAND



(F)BGC 7

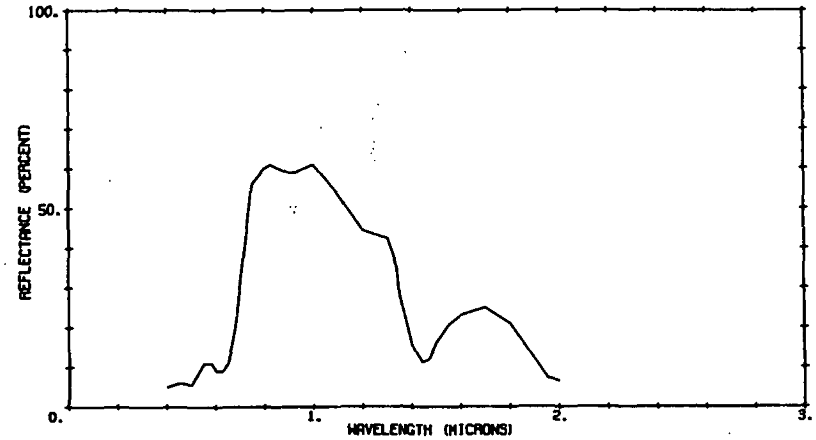
B01643 123

SUGAR BEETS, NORMAL STAND



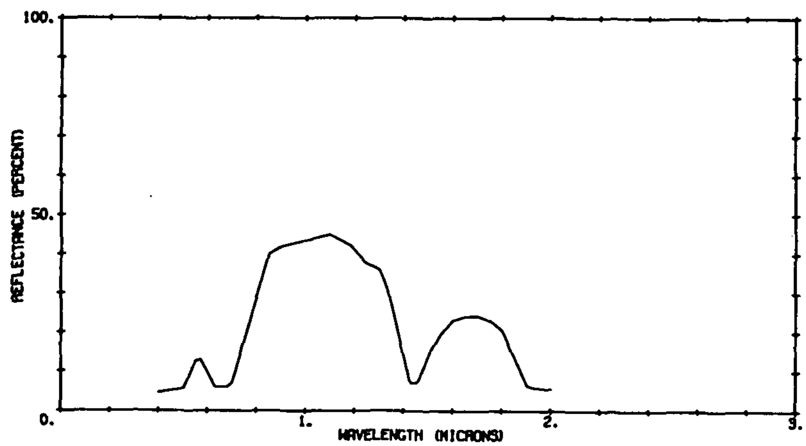
B01643 124

SUGAR BEETS, NORMAL STAND



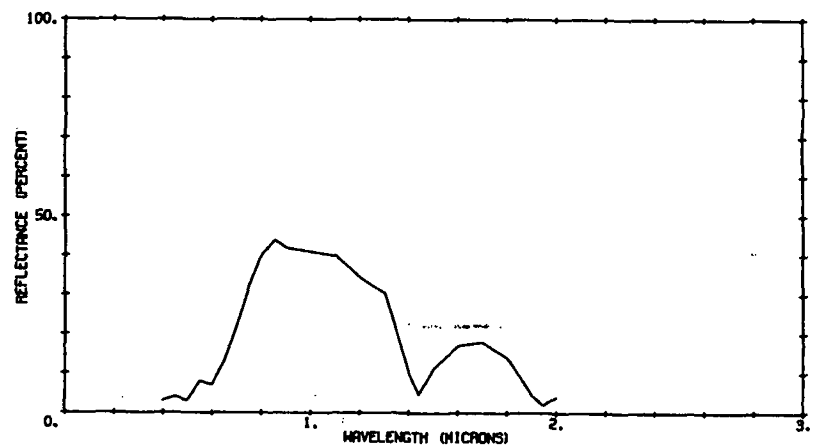
B01643 125

SUGAR BEETS, NORMAL STAND



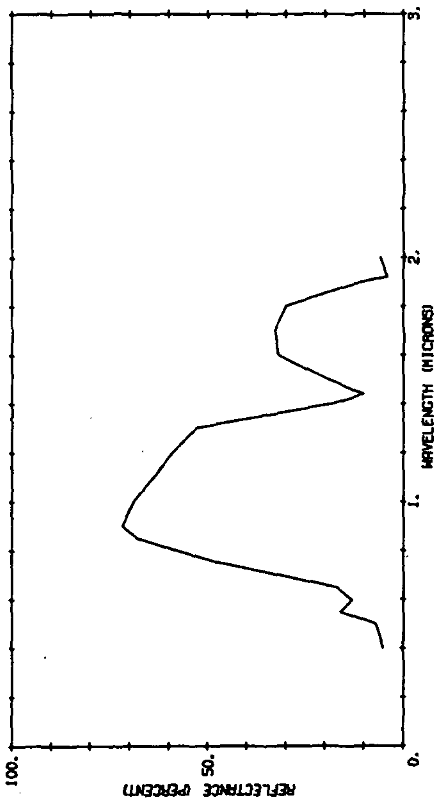
B01643 126

SUGAR BEETS, NORMAL STAND



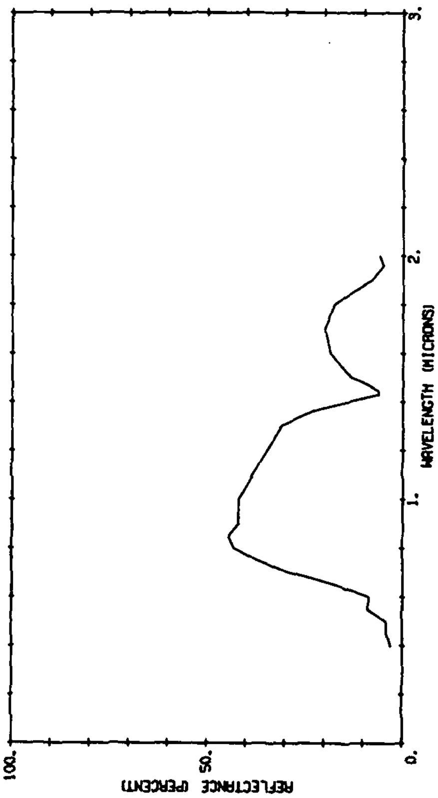
B01643 127

SUGAR BEETS, NORMAL STAND



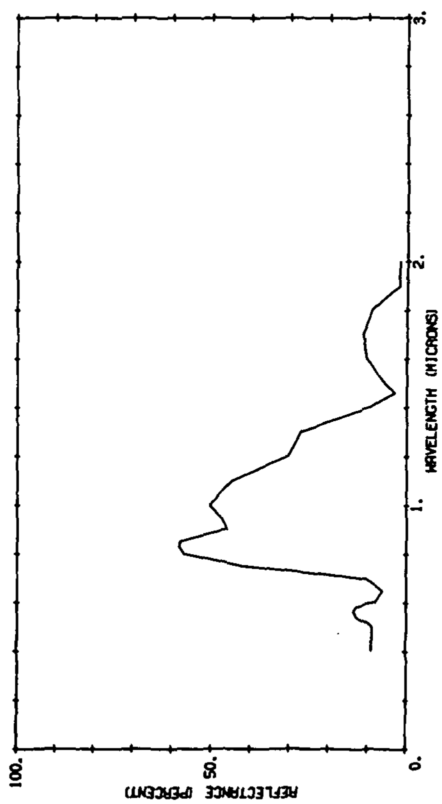
B01643 128

SUGAR BEETS, NORMAL STAND



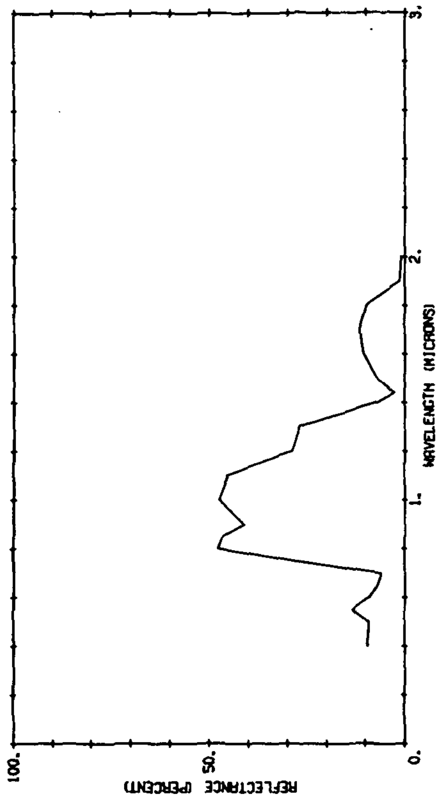
B01643 129

CABBAGE, NORMAL STAND



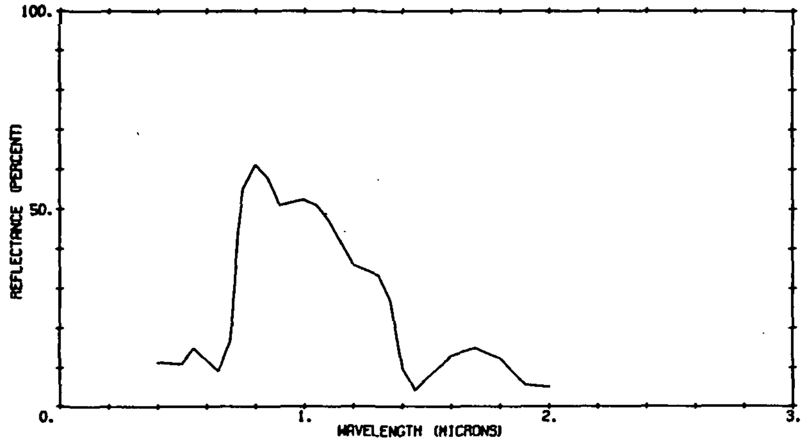
B01643 130

CABBAGE, NORMAL STAND



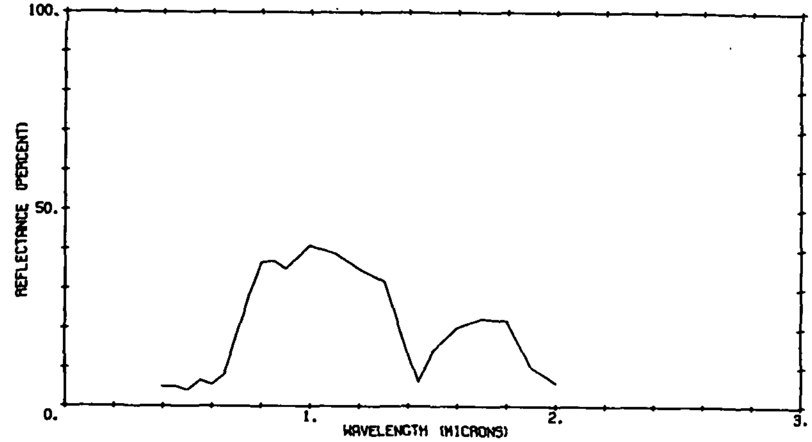
B01643 131

CABBAGE, NORMAL STAND



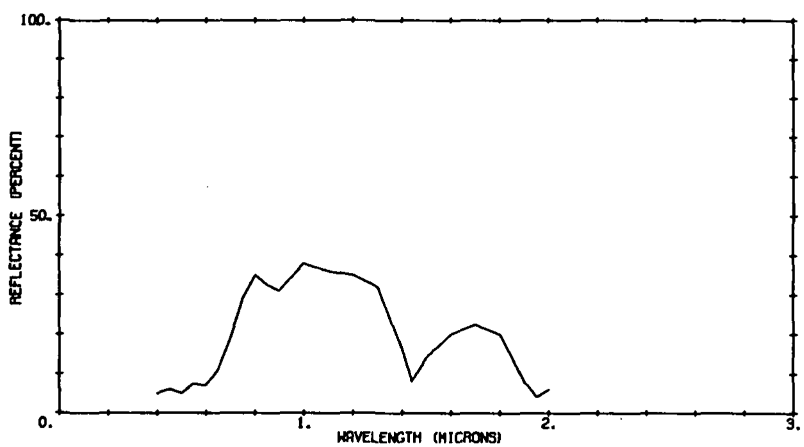
B01643 132

SQUASH, NORMAL STAND



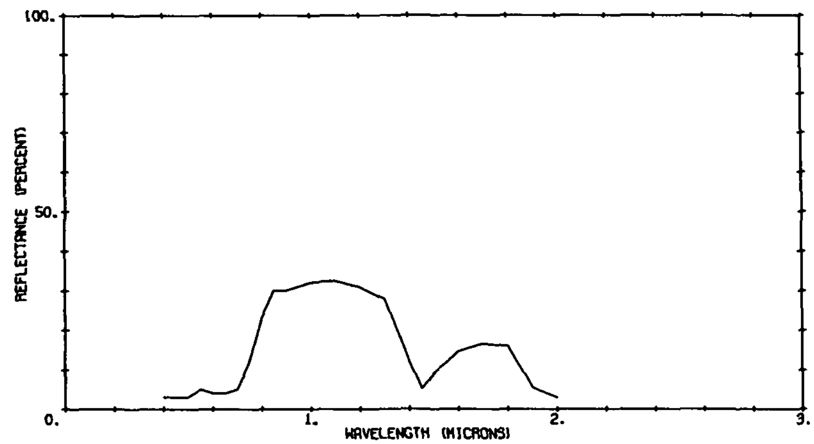
B01643 133

SQUASH, NORMAL STAND



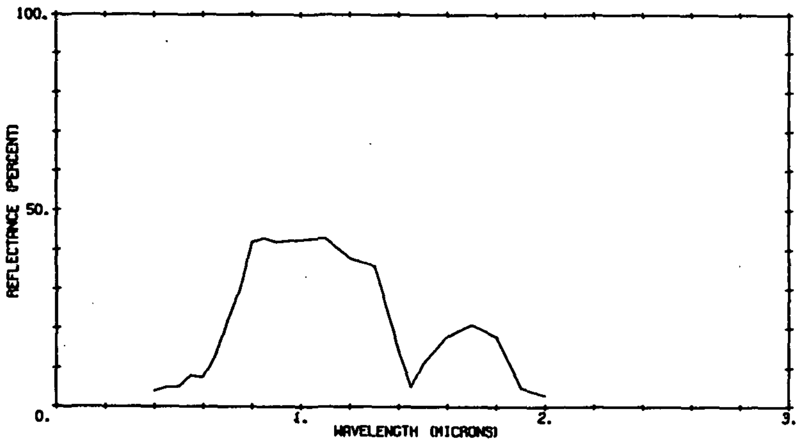
B01643 134

SQUASH, NORMAL STAND



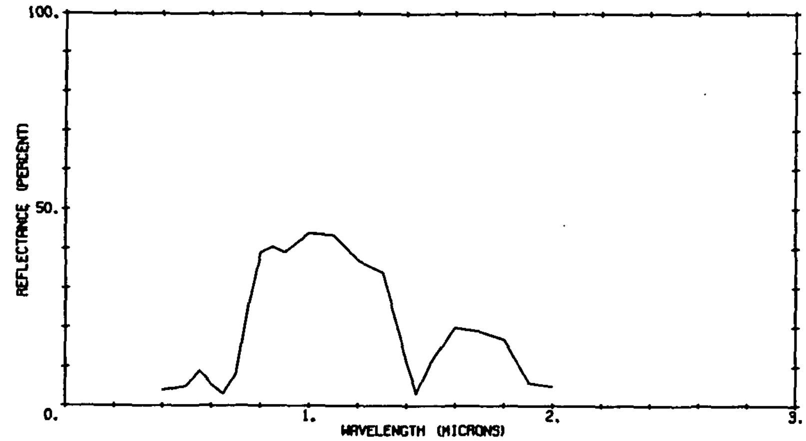
B01643 135

LIMA BEANS, NORMAL STAND



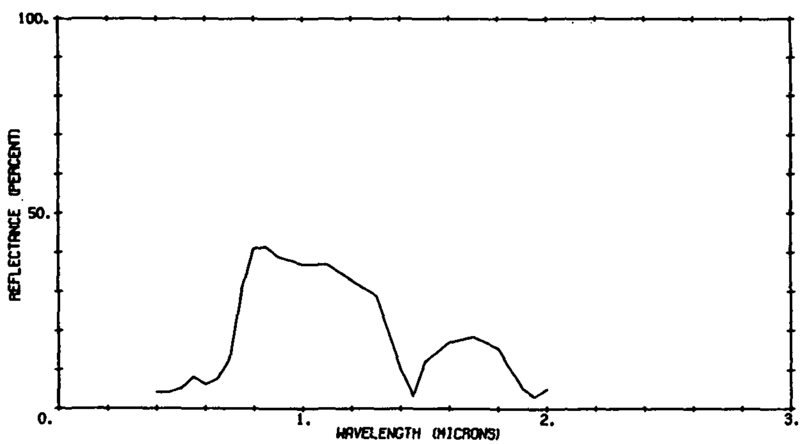
B01643 136

LIMA BEANS, NORMAL STAND



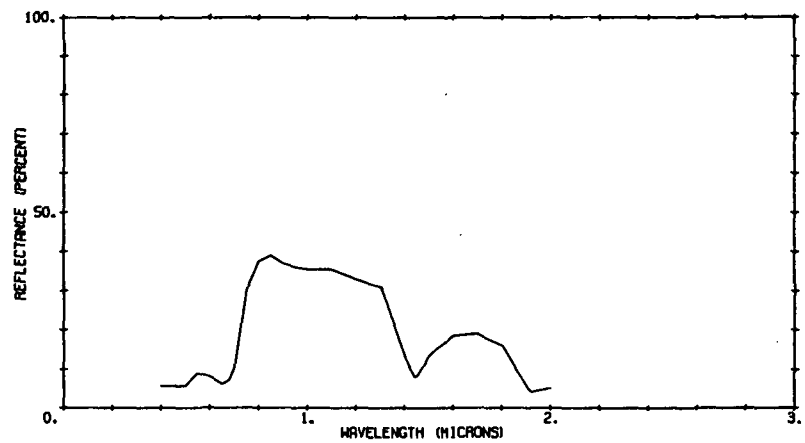
B01643 137

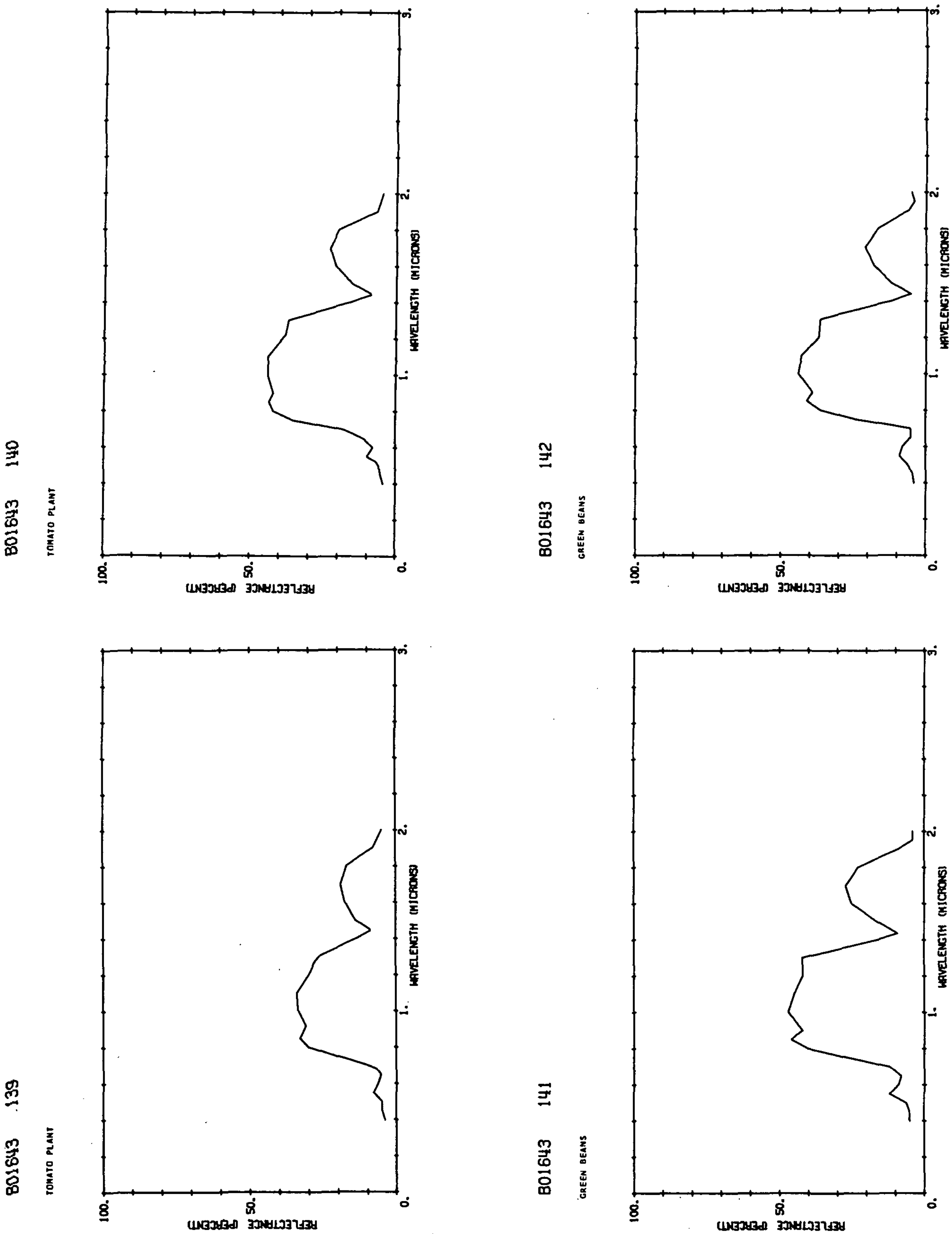
LIMA BEANS, NORMAL STAND



B01643 138

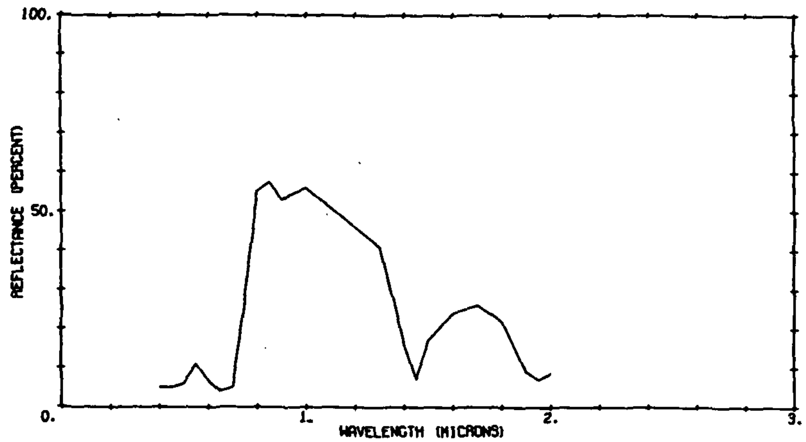
TOMATO PLANT




B01643 140
TOMATO PLANT
B01643 142
GREEN BEANS
B01643 139
TOMATO PLANT
B01643 141
GREEN BEANS
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

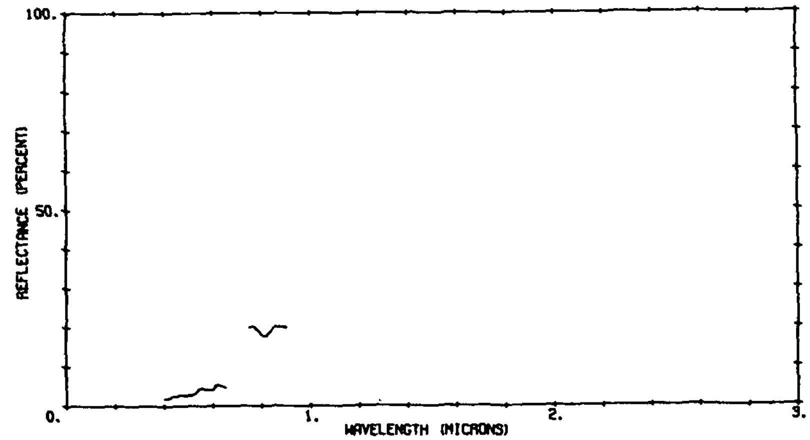
B01643 143

GREEN BEANS



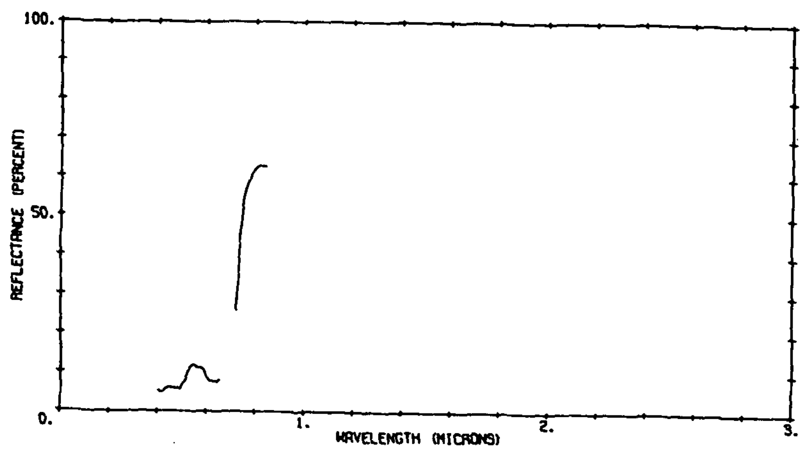
B03995 053

HEATHER, DENSE GROWTH, BEFORE FLOWERING, NORMAL



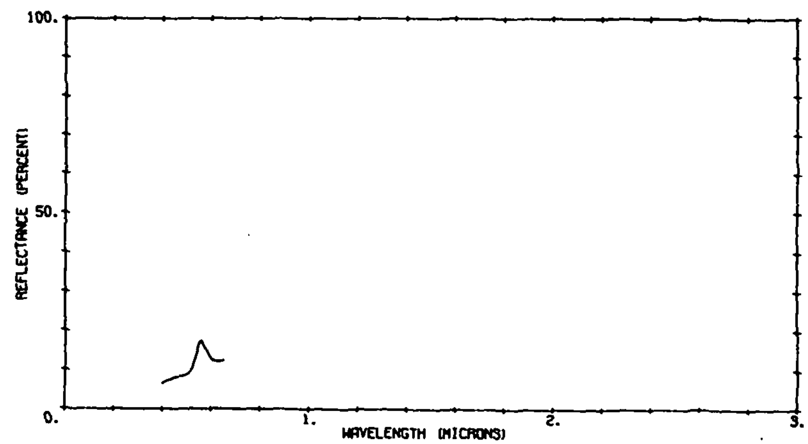
B03995 069

REEDS, IN A LAKE NEAR THE BANK, BRIGHT GREEN EARLY AUTUMN
A=90DEGREES



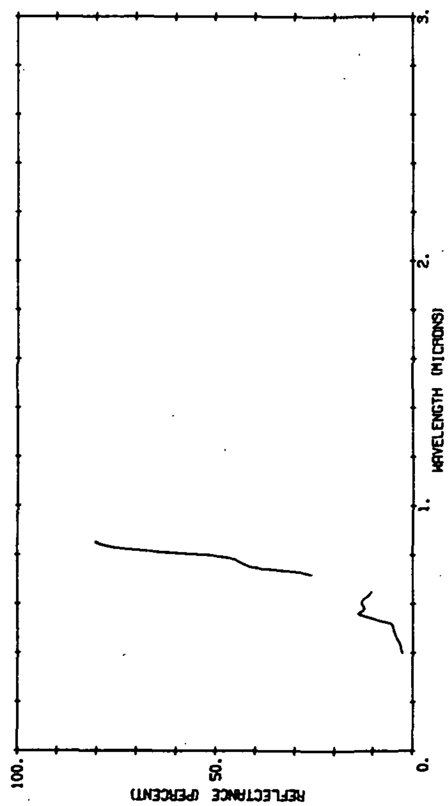
B03995 082

MEADOW WITH CLOVER AND TIMOTHY, DENSE GROWTH, WITH FLOWERS,
MID-SUMMER A=90 DEGREES, ANG.=45 DEGREES



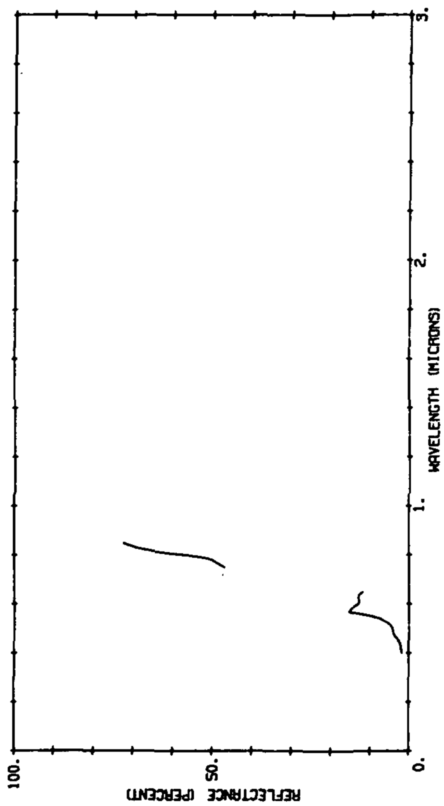
B03995 089

MEADOW WITH CROW FOOT, DENSE GRASS WITH ABUNDANT FLOWERS
A=90 DEGREES, ANG.=45 DEGREES



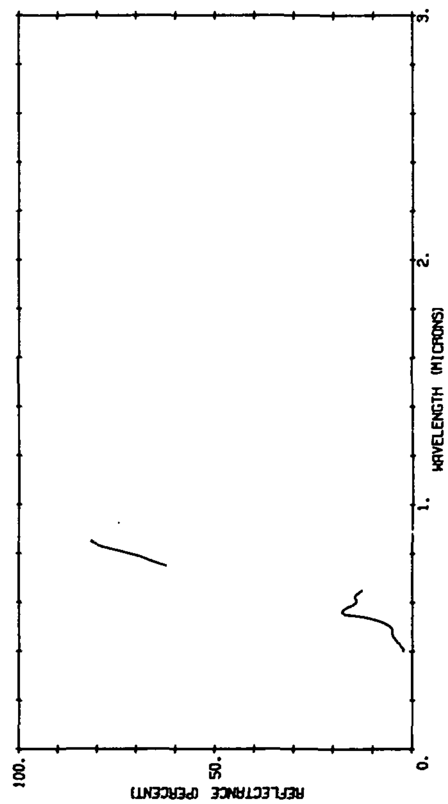
B03995 090

MEADOW WITH CROW FOOT, DENSE GRASS WITH ABUNDANT FLOWERS
A=90 DEGREES, ANG.=65 DEGREES



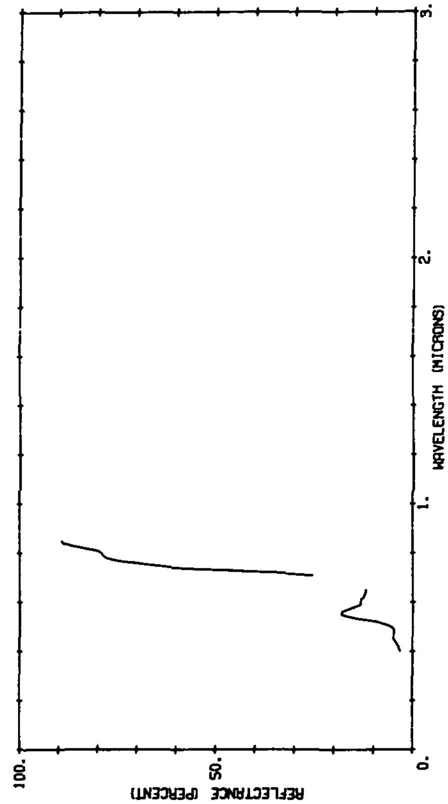
B03995 091

MEADOW WITH CROW FOOT, DENSE GRASS WITH ABUNDANT FLOWERS
A=90 DEGREES, ANG.=85 DEGREES



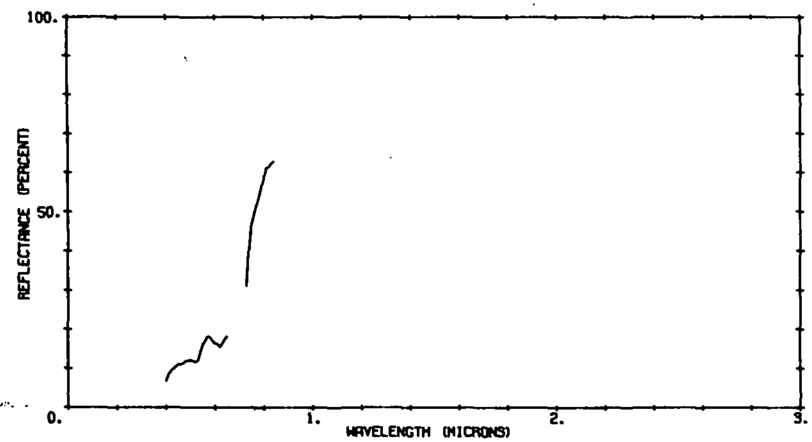
B03995 092

SEDGE MEADOW, DENSE GRASS IN MID-SUMMER A=90 DEGREES,ANG.=4
5 DEGREES



B03995 144

LAKE PARTIALLY COVERED WITH VEGETATION, SURFACE OF WATER IS ALMOST COMPLETELY COVERED WITH VEGETATION (DUCKWEED, SEDGE AND OTHERS) A=9C DEGREES, ANG.=60 DEGREES

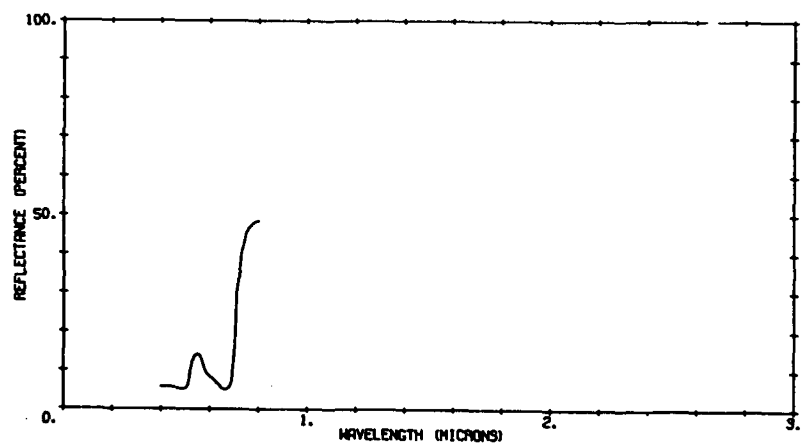


B03995 145

SEDGE, DENSE NEAR SHORE A=90 DEGREES, ANG.=45 DEGREES

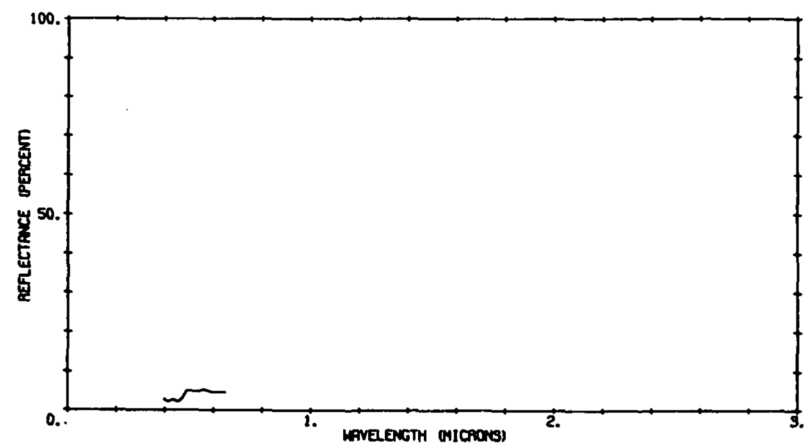
B03995 147

PLAINTAIN, INDIVIDUAL LEAF (TOP SURFACE) NORMAL



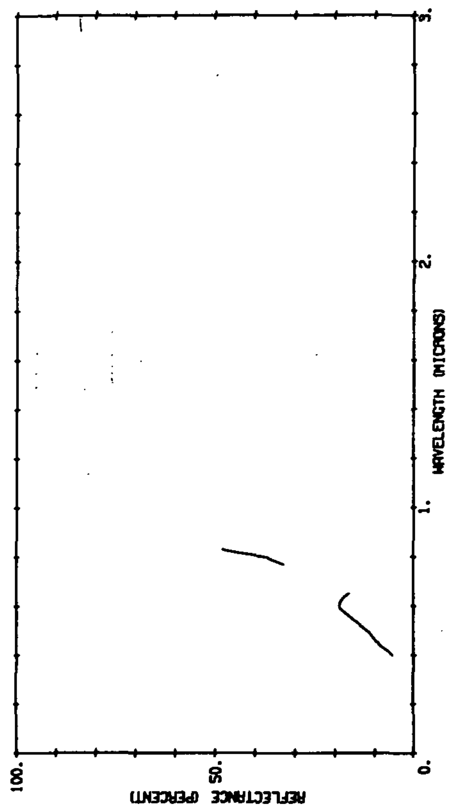
B03995 151

STREAM, SURFACE COVERED WITH WATER, WEEDS, AND SEDGE, A=90 D EGREES, ANG.=45 DEGREES



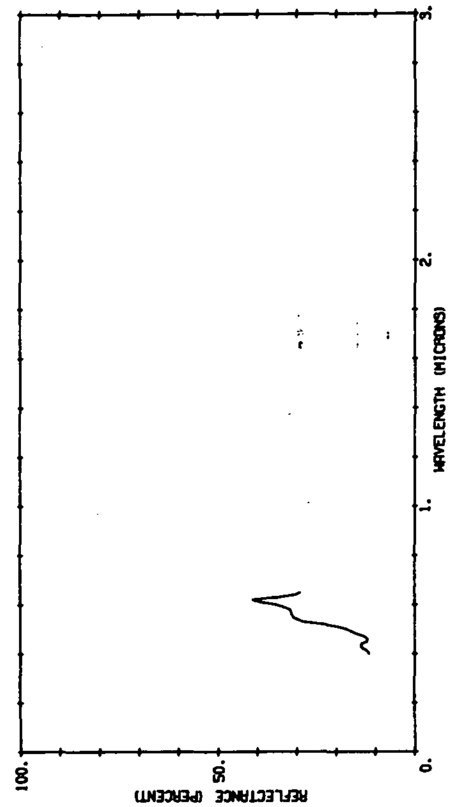
B03995 153

SELIN, INDIVIDUAL CLUMPS DRIED AND YELLOWISH ON SAND DUNES AT END OF SUMMER, NORMAL



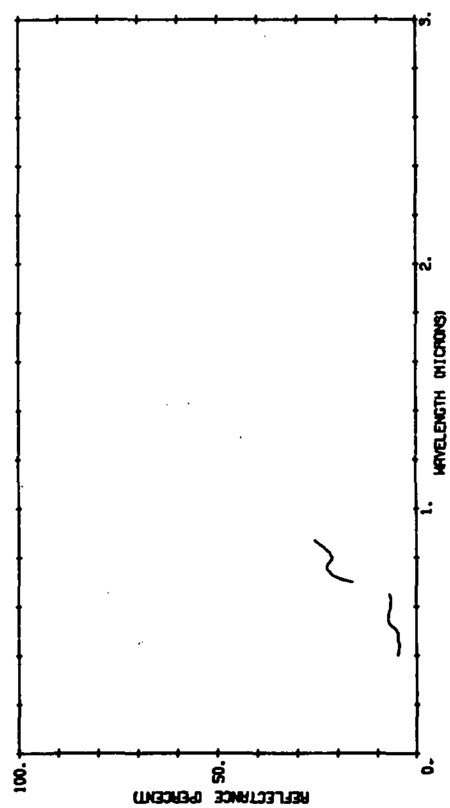
B03995 177

PEAS, YELLOWED WITH BRIGHT GREEN SPOTS, A=90 DEGREES, ANG.=45 DEGREES



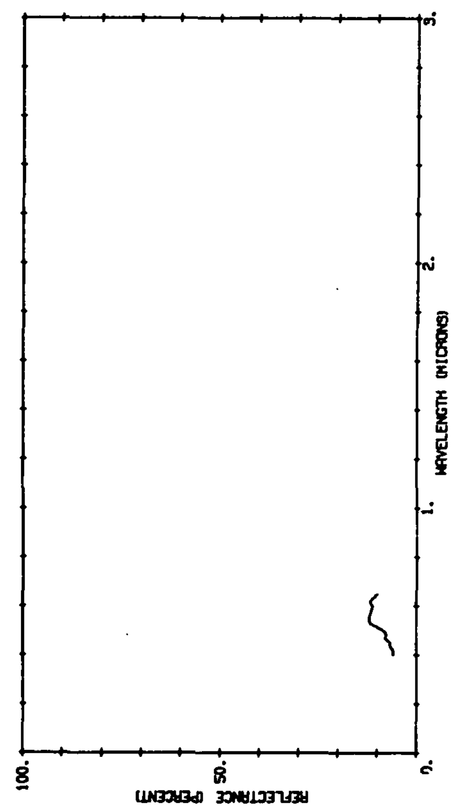
B03995 152

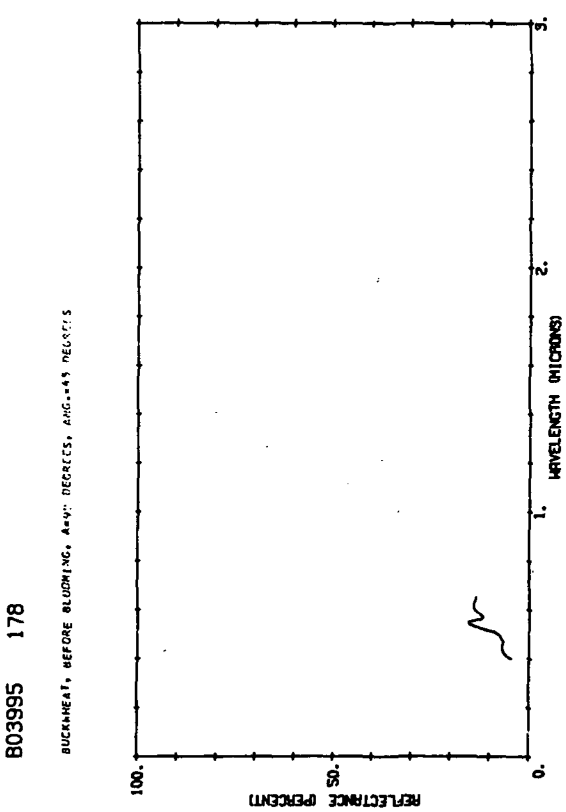
DUCKWEED, DENSE BUNCHED GROWTH, LIGHT GREEN, BEGINNING OF SUMMER, A=90 DEGREES, ANG.=45 DEGREES

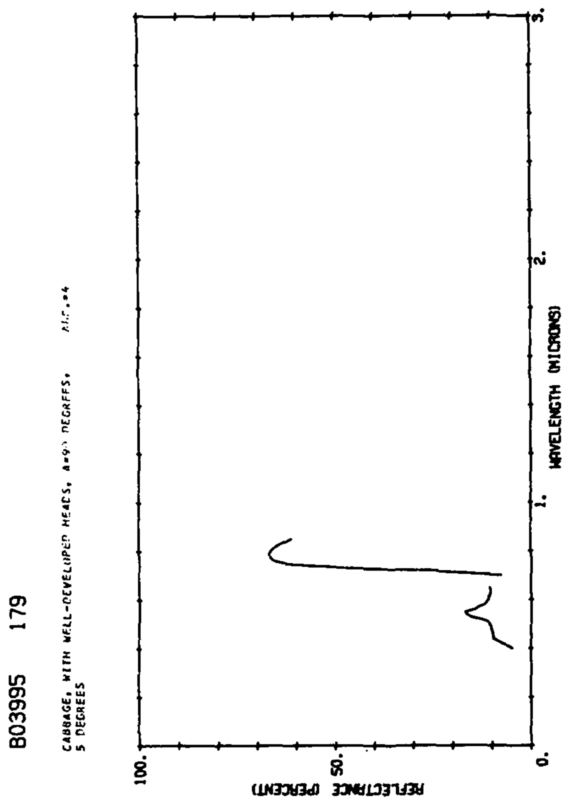


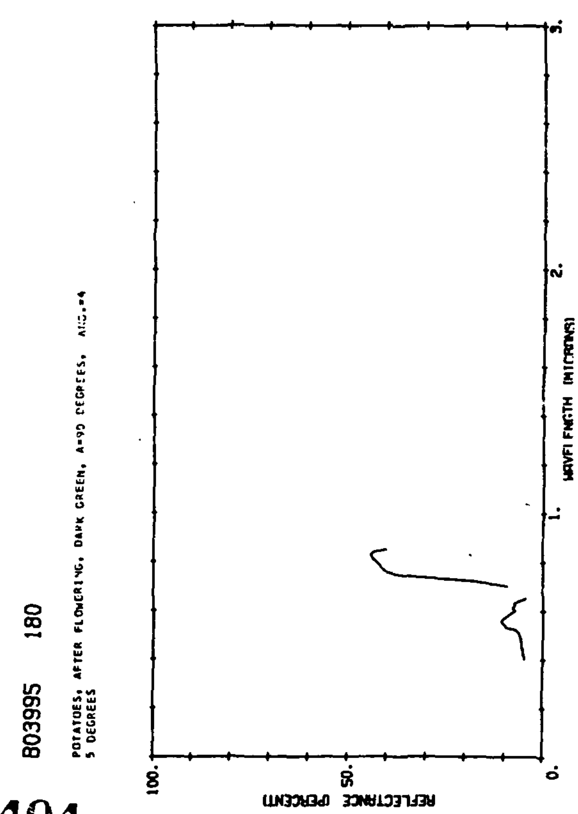
B03995 176

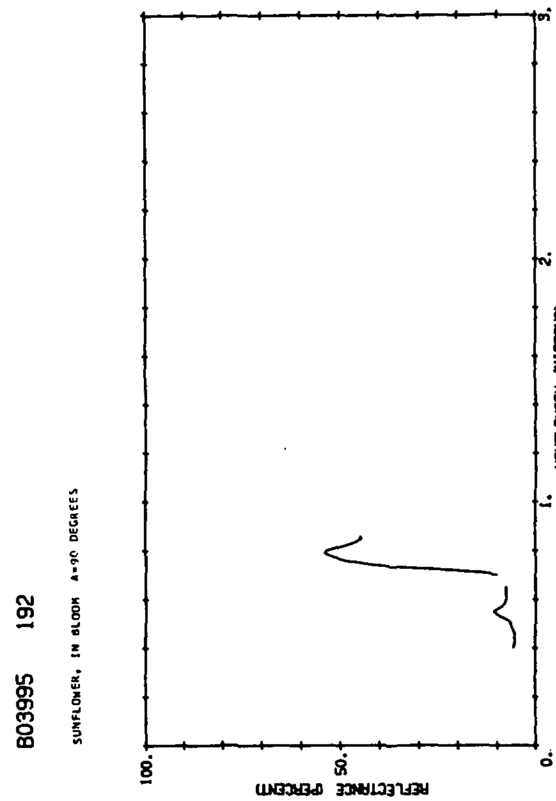
VETCH, DENSE BRIGHT GREEN BEFORE FLOWERING,A=90DEG ANG=45DEG




B03995 178
BUCKWHEAT, BEFORE BLOOMING, A=90 DEGREES, ANG.=45 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

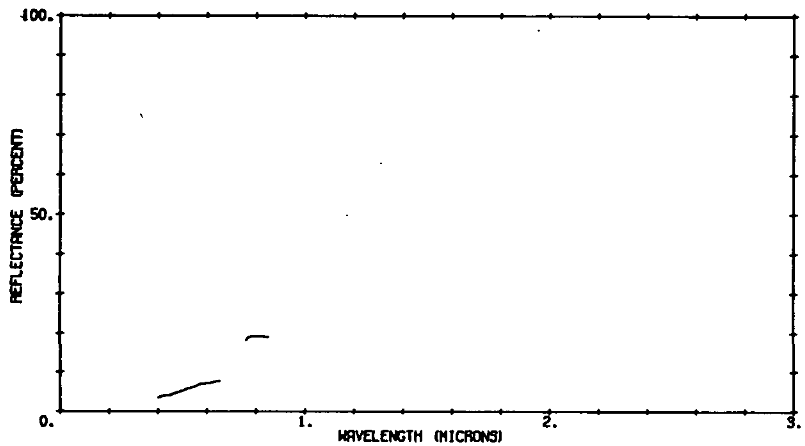

B03995 179
CABBAGE, WITH WELL-DEVELOPED HEADS, A=90 DEGREES, ANG.=4
5 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B03995 180
POTATOES, AFTER FLOWERING, DARK GREEN, A=90 DEGREES, ANG.=4
5 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.


B03995 192
SUNFLOWER, IN BLOOM A=90 DEGREES
REFLECTANCE (PERCENT)
100.
50.
0.
WAVELENGTH (MICRONS)
1.
2.
3.

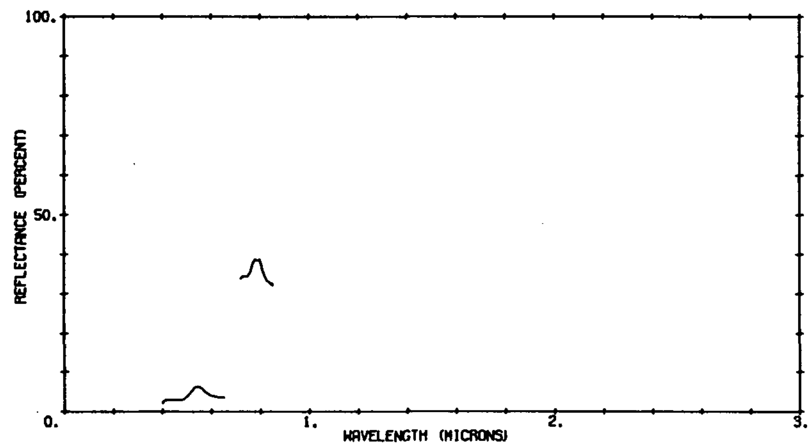
B03995 194

LENTIL FIELD, STUBLE, NORMAL



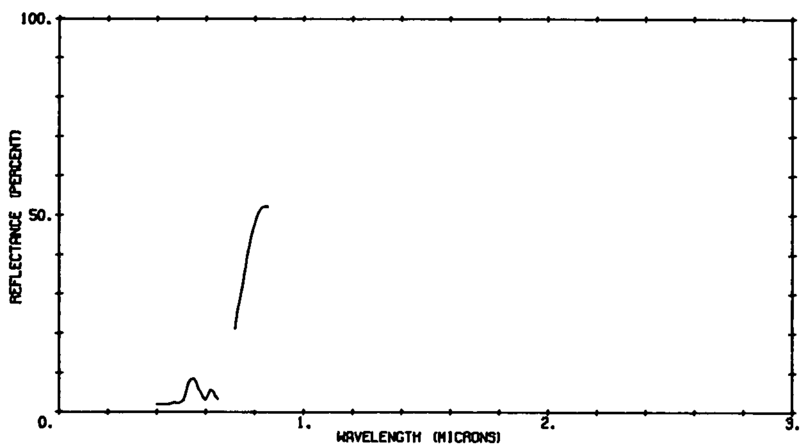
B03995 196

TOMATOES, DENSE VEGETATION, A=90 DEGREES, ANG.=45 DEGREES



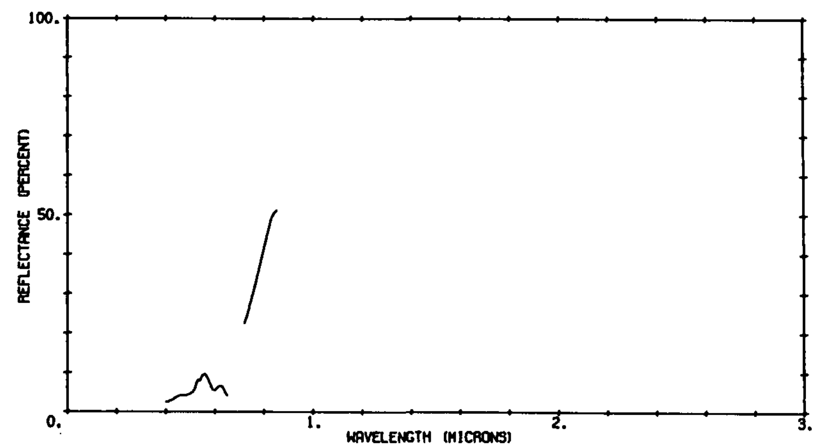
B03995 197

MILLET, RIPENING, NORMALBLACK EARTH

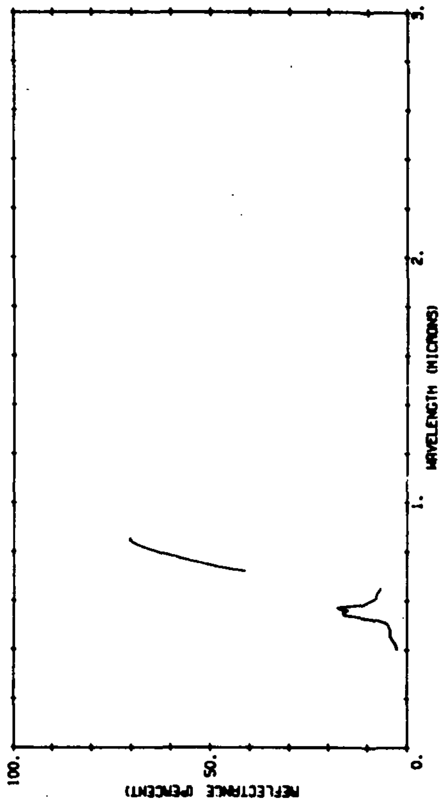


B03995 198

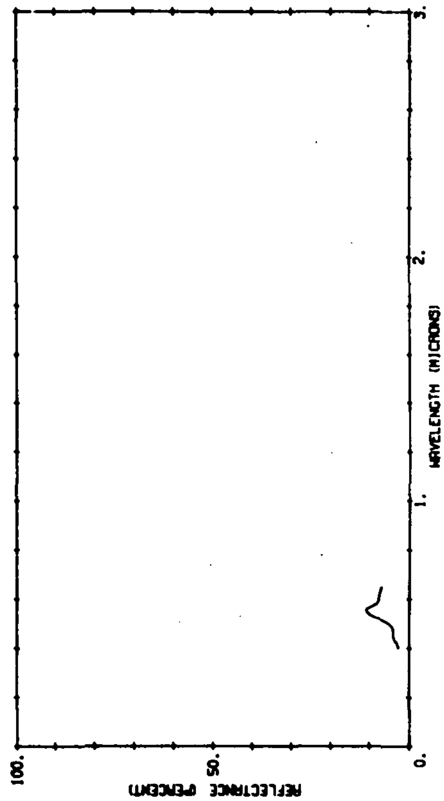
MILLET, RIPENING, A=0 DEGREES, ANG.=45 DEGREES BLACK EARTH



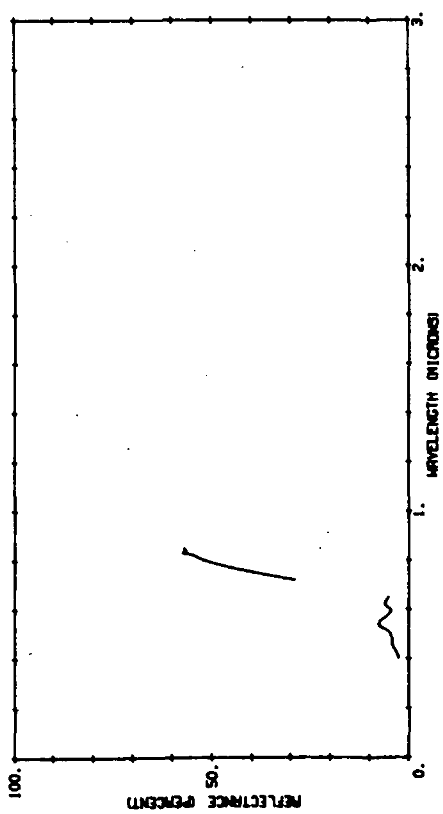
B03995 200



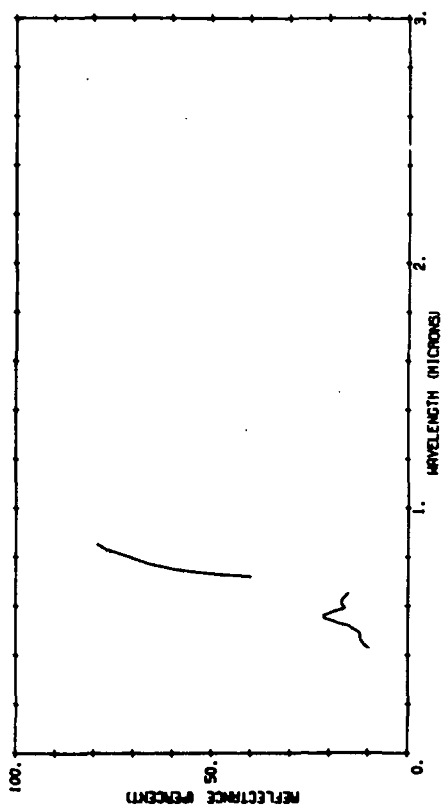
B03995 215



B03995 199



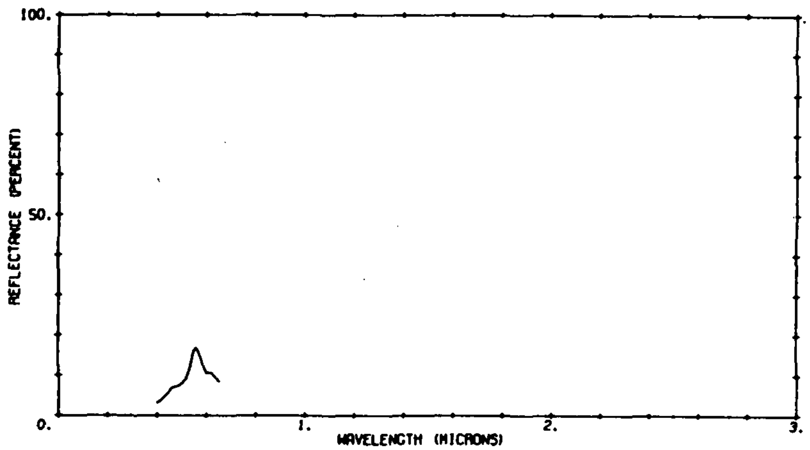
B03995 214



C-8

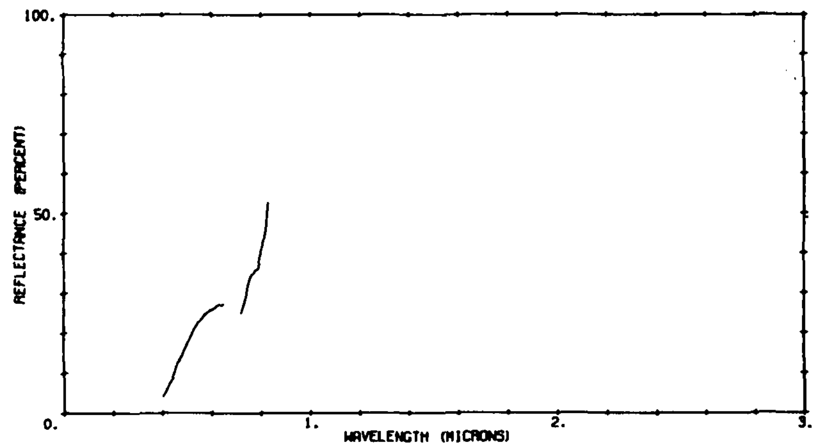
B03995 216

SUMMER RYE, SPIKED, A=90 DEGREES, [illegible]



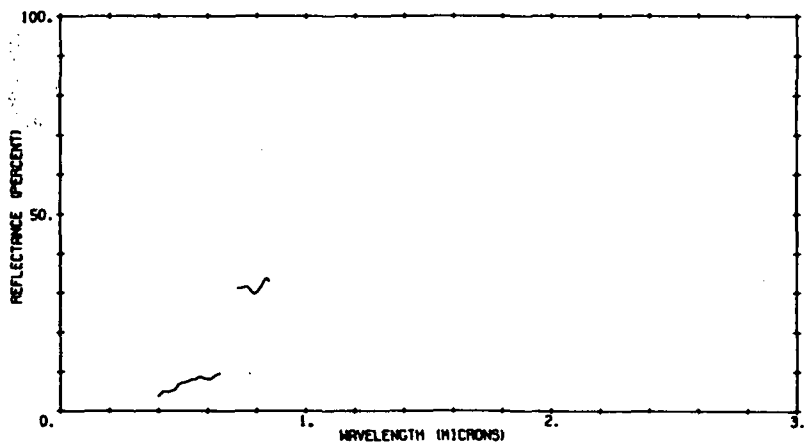
B03995 219

RYE STRAW, IN SHEAVES, NORMAL, BLACK EARTH



B03995 220

LENTIL STRAW, IN SHEAVES, NORMAL BLACK EARTH

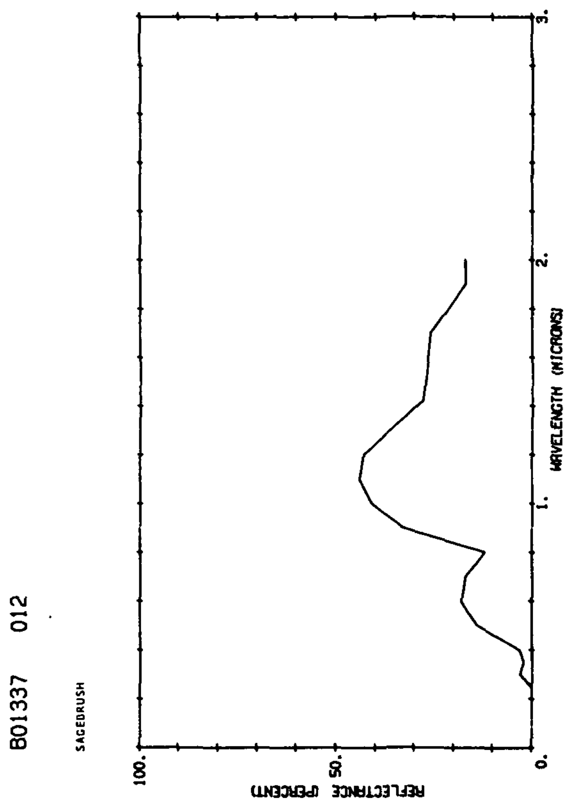


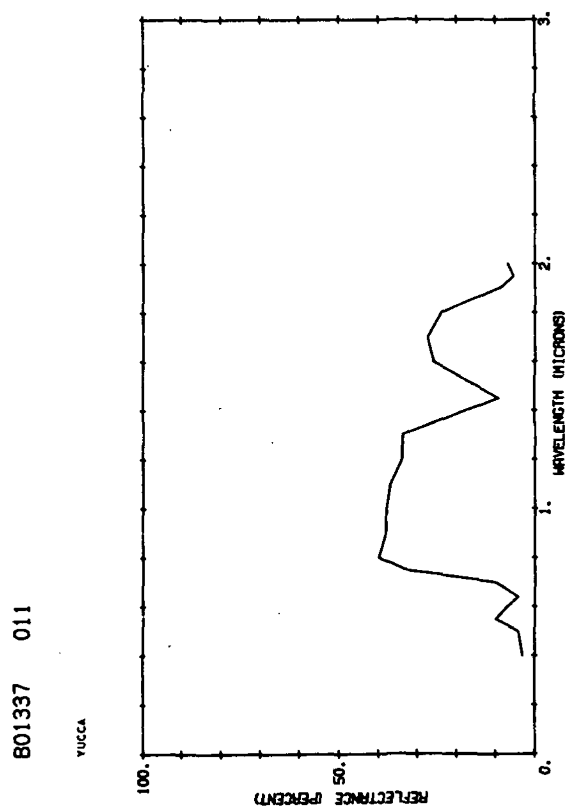
(F)BGD

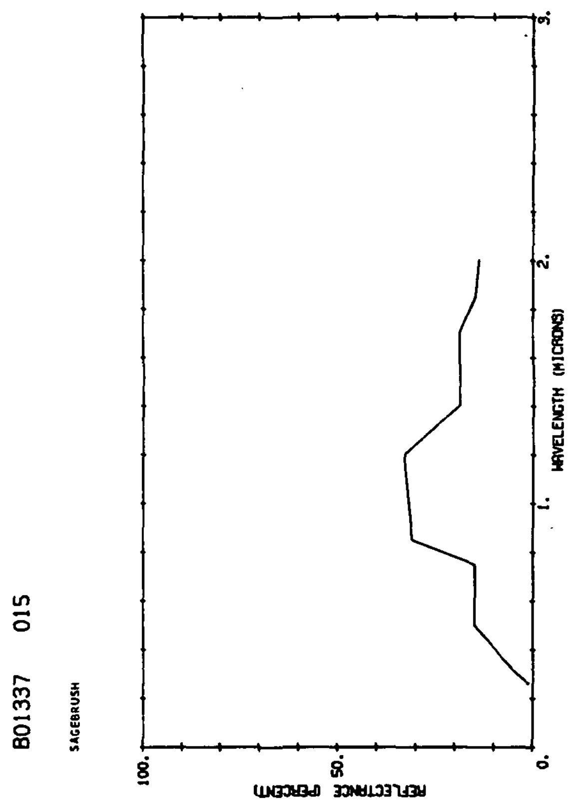
VEGETATION

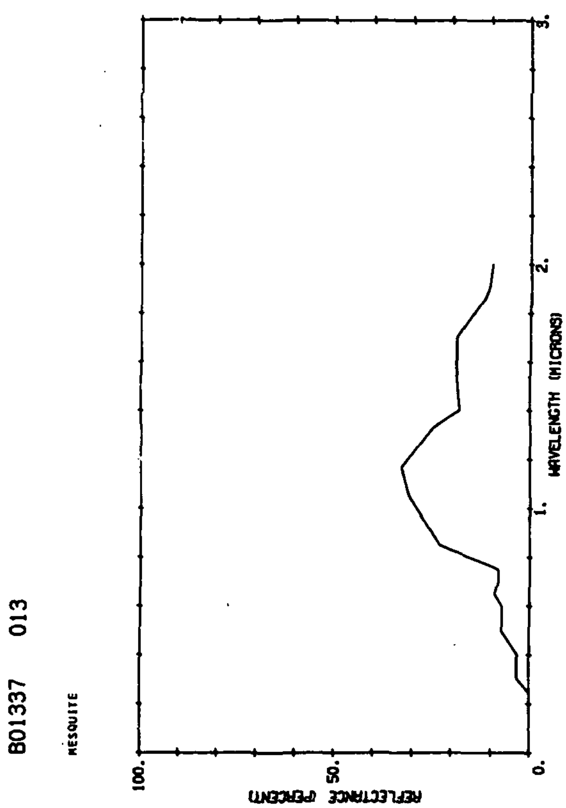
Ligneous

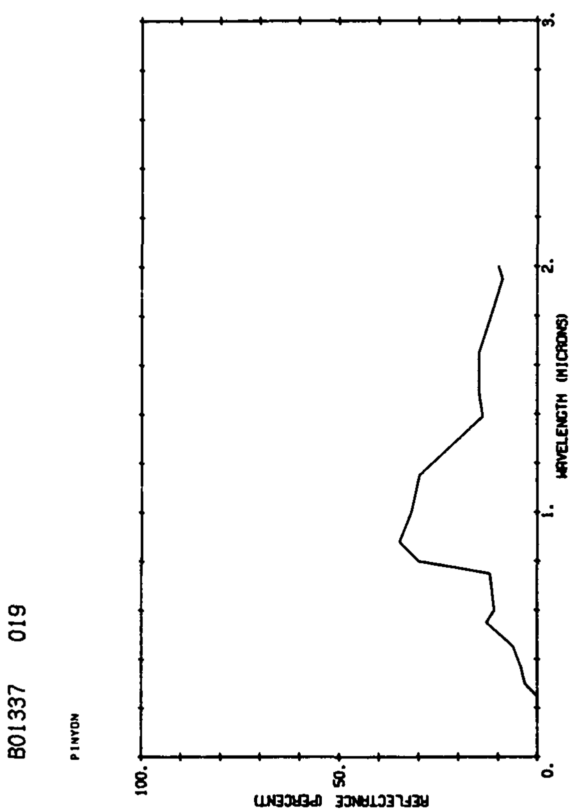
408


B01337 012
SAGEBRUSH
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

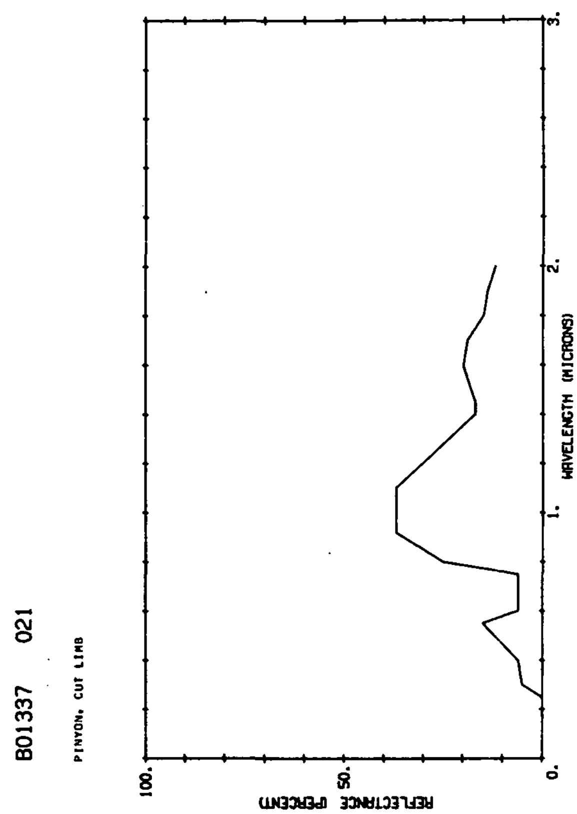

B01337 011
YUCCA
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B01337 015
SAGEBRUSH
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

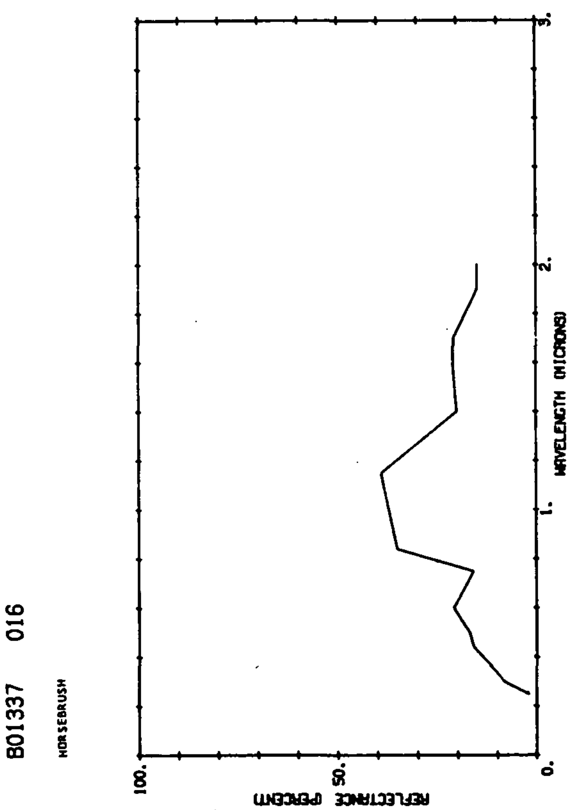

B01337 013
MESQUITE
100.
50.
0.
REFLECTANCE (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)



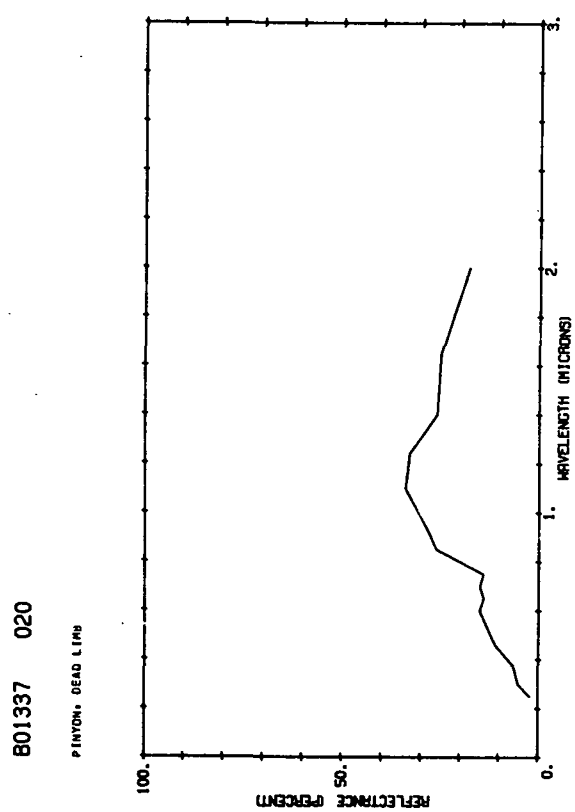
B01337 019
PINYON
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)



B01337 021
PINYON, CUT LIMB
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)



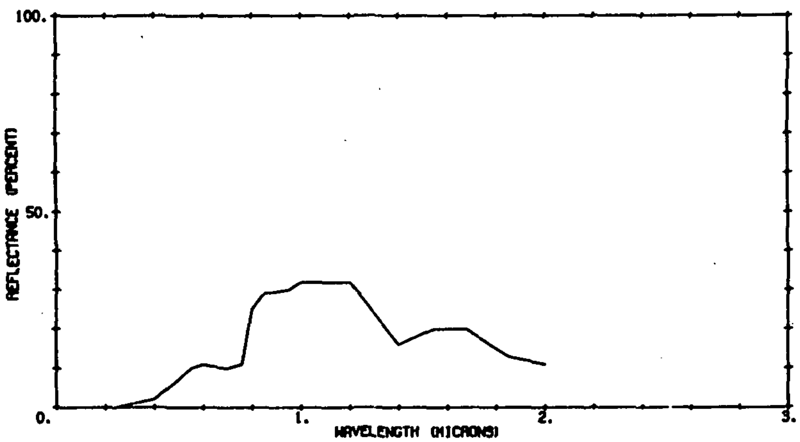
B01337 016
HORSEBRUSH
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)



B01337 020
PINYON, DEAD LIMB
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)

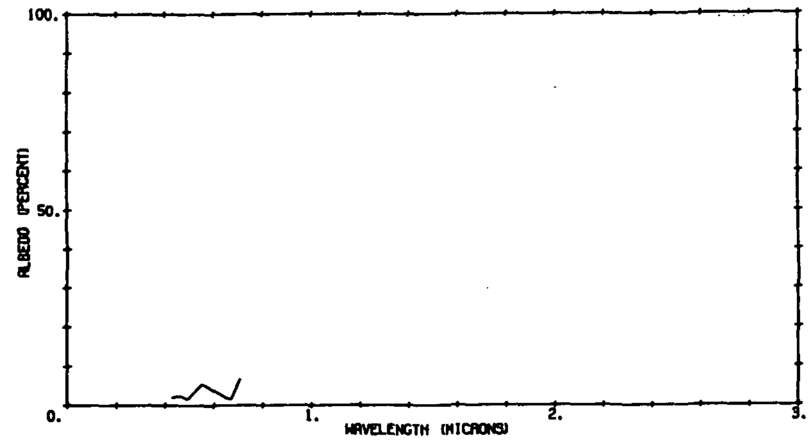
B01337 027

RABBIT BUSH



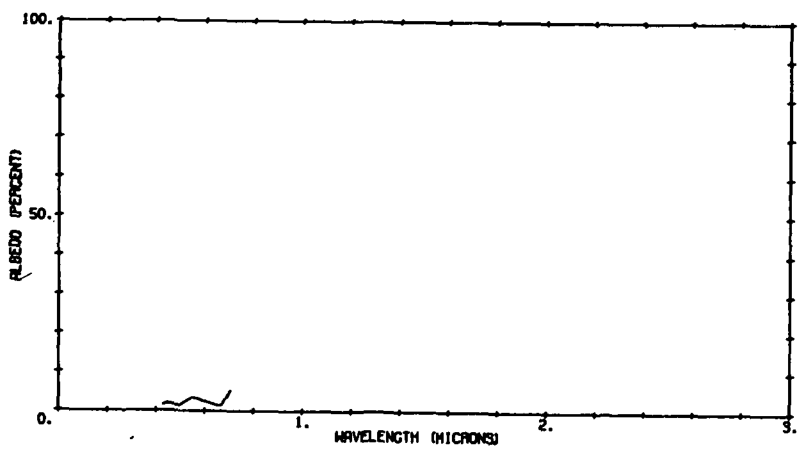
B01370 010

TREE GROWTH, LIGHT GREEN (ORLANDO, FLORIDA)



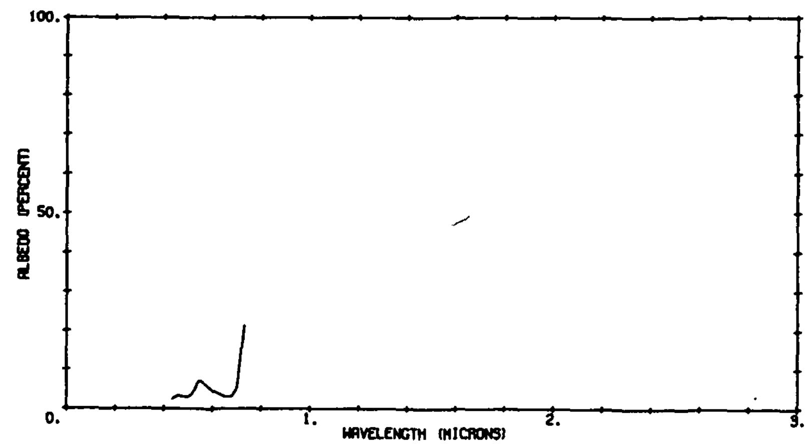
B01370 011

TREE GROWTH, DARK GREEN (ORLANDO, FLORIDA)



B01370 012

ORCHARD TREE (ORLANDO, FLORIDA)

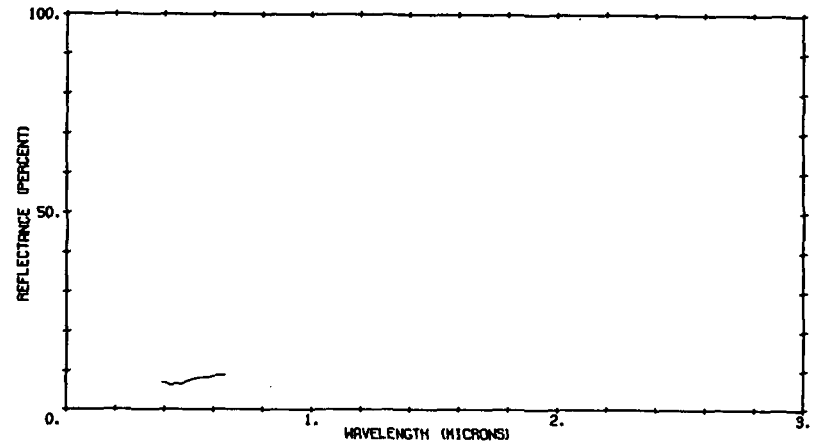


B01370 014

TREE, GREEN IN BROWN FIELD (ORLANDO, FLORIDA)

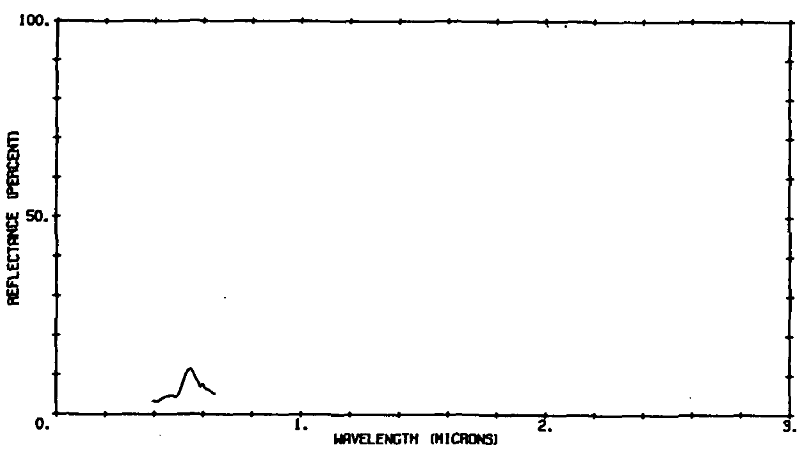
B03995 028

LINDEN, MATURE FOREST, WINTER STAGE



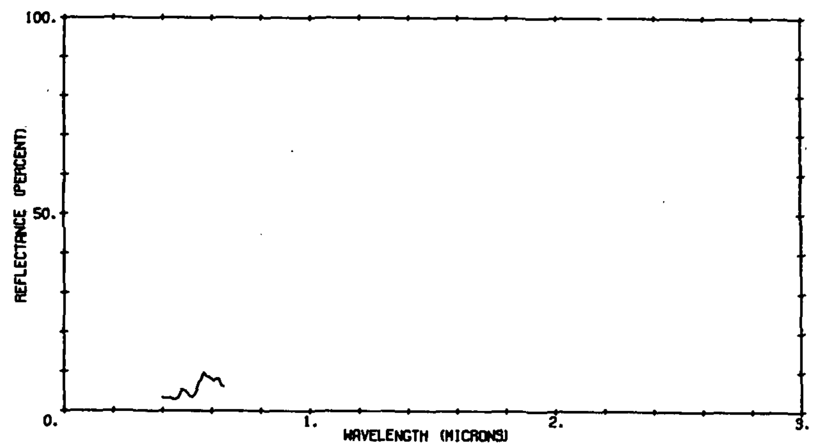
B03995 029

LINDEN, MATURE FOREST, FULL LEAF STAGE



B03995 030

LINDEN, MATURE FOREST, AUTUMN COLOR

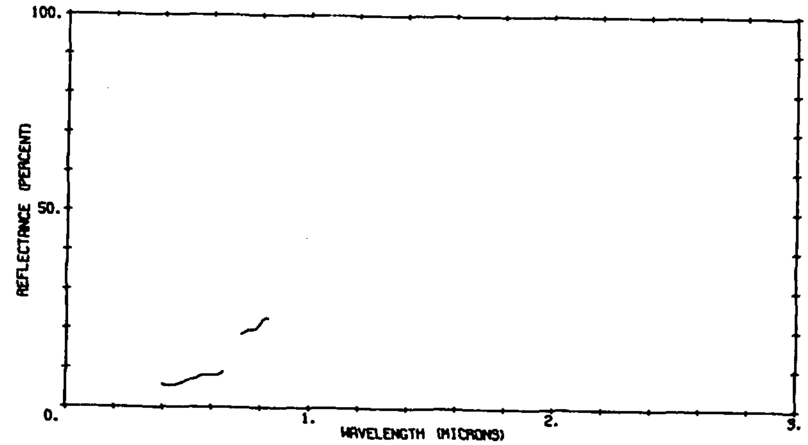


B03995 035

ALDER, YOUNG FOREST, YOUNG LEAF STAGE

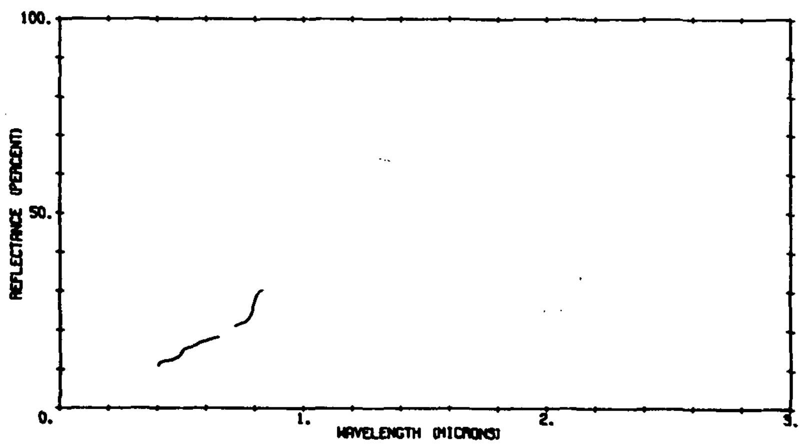
B03995 148

WORMWOOD, DENSE GROWTH, FLOWERING, AT END OF SUMMER, CLOUDY
SKY, NORMAL



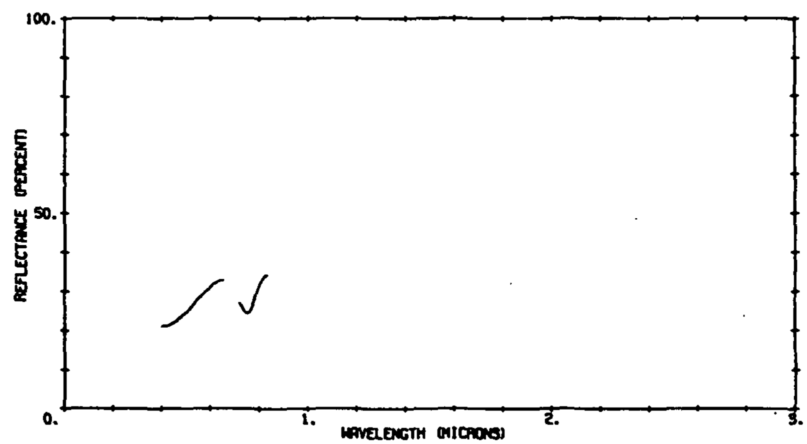
B03995 149

WORMWOOD, DENSE GROWTH, FLOWERING, AT END OF SUMMER, CLOUDY
DAY, ANG.=30 DEGREES



B03995 150

WORMWOOD, DENSE GROWTH, FLOWERING, AT END OF SUMMER, CLOUDY
DAY, ANG.=63 DEGREES



(F)BGE

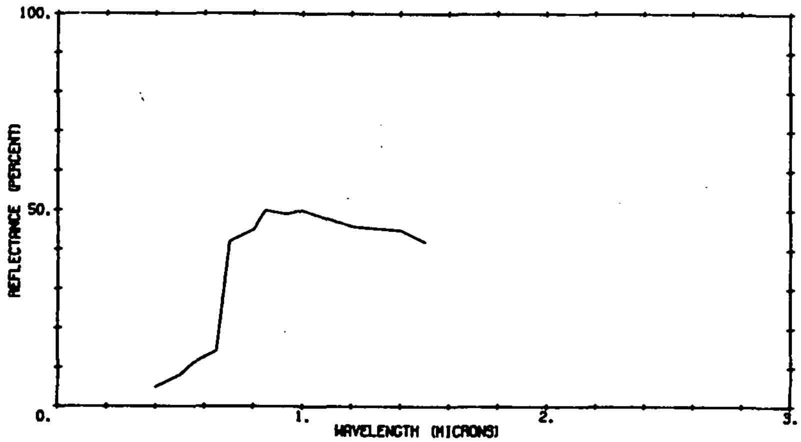
VEGETATION

Ligneous (Continued)

414

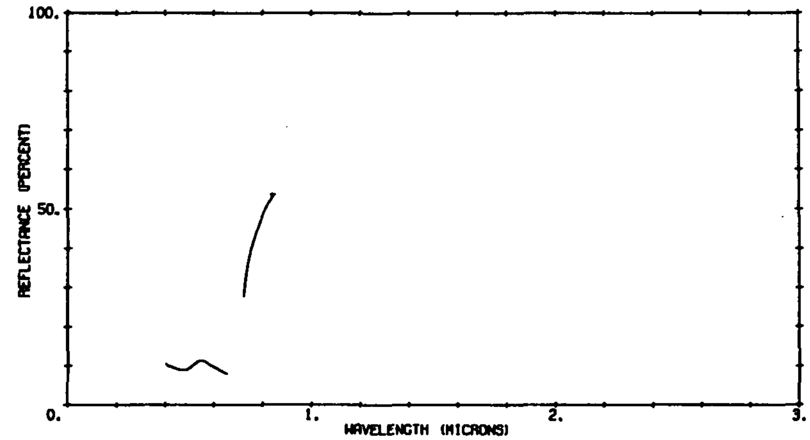
B01337 006

DWARF WILLOW



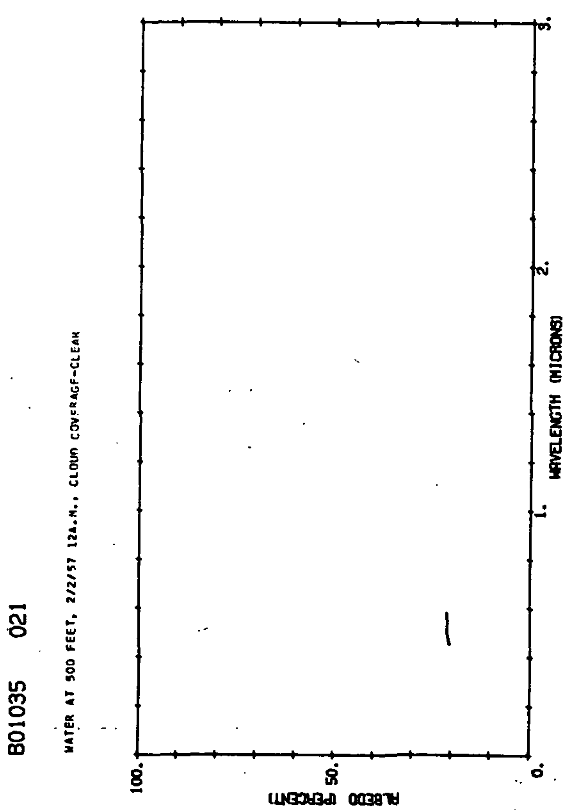
B03995 026

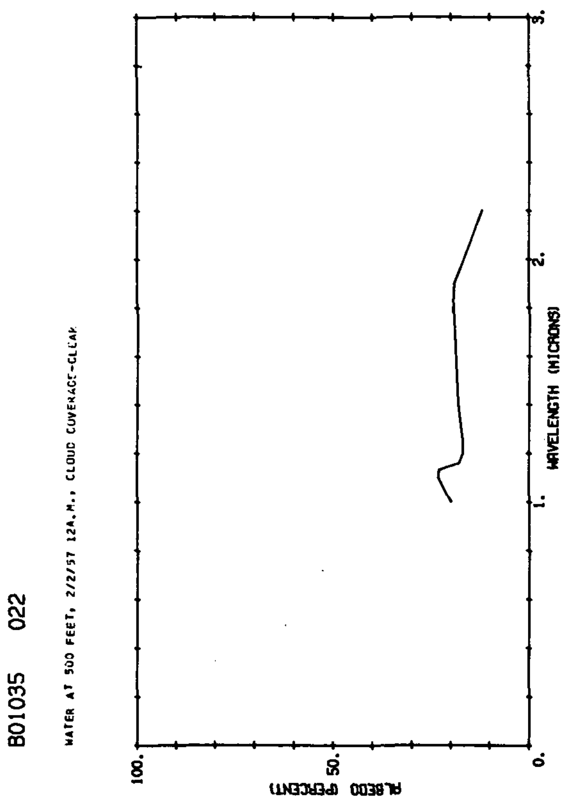
WILLOW SHRUBS, LATE SUMMER, GREEN

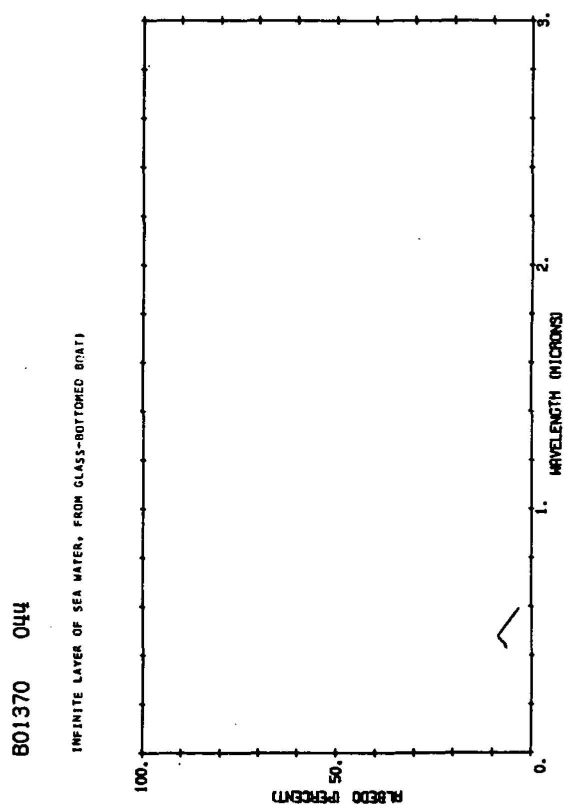


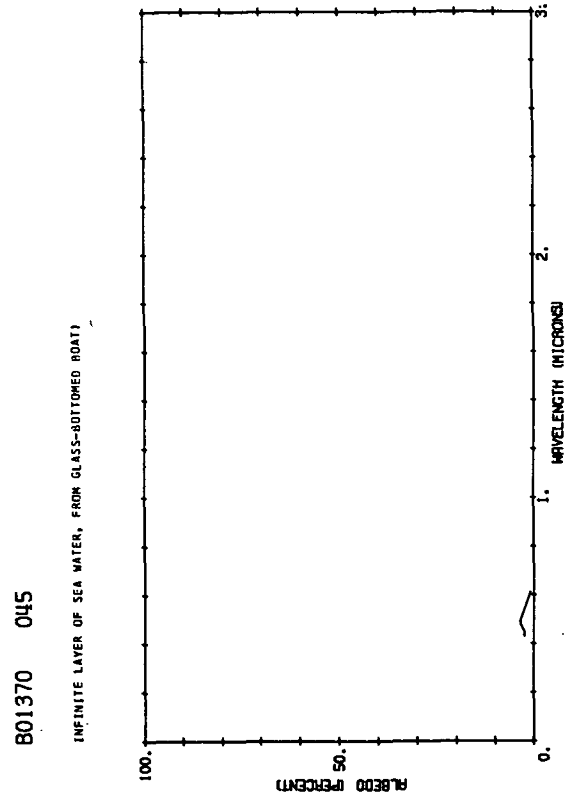
(F)BH
WATER

416


B01035 021
WATER AT 500 FEET, 2/2/57 12A.M., CLOUD COVERAGE-CLEAR
100.
50.
0.
ALBEDO (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

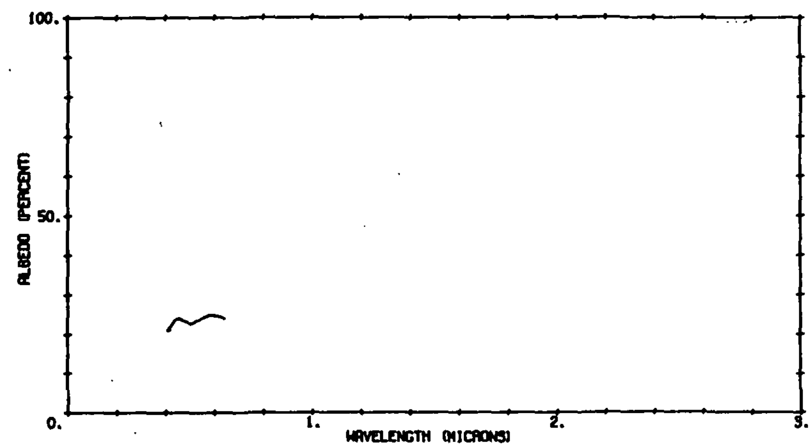

B01035 022
WATER AT 500 FEET, 2/2/57 12A.M., CLOUD COVERAGE-CLEAR
100.
50.
0.
ALBEDO (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B01370 044
INFINITE LAYER OF SEA WATER, FROM GLASS-BOTTOMED BOAT)
100.
50.
0.
ALBEDO (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)


B01370 045
INFINITE LAYER OF SEA WATER, FROM GLASS-BOTTOMED BOAT)
100.
50.
0.
ALBEDO (PERCENT)
1.
2.
3.
WAVELENGTH (MICRONS)

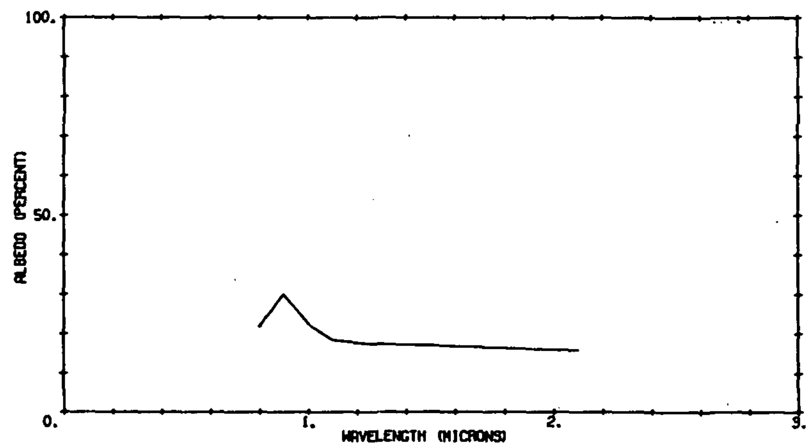
B01035 023

WATER AT 5000 FEET, 2/2/57 1P.M., CLOUD COVERAGE-CLEAR



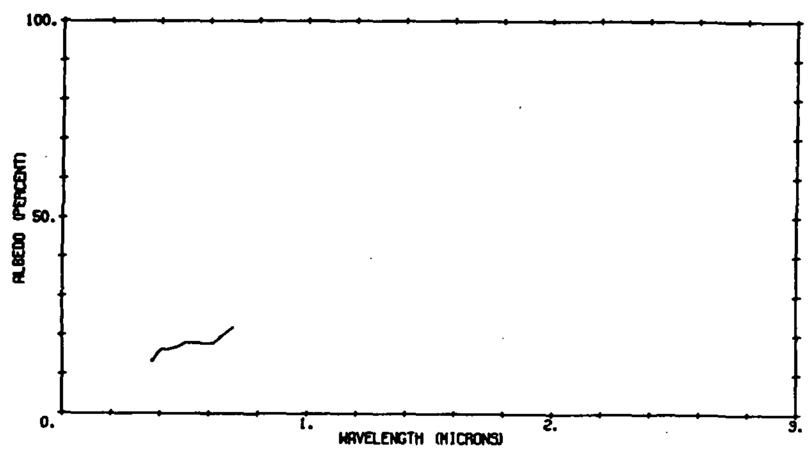
B01035 024

WATER AT 5000 FEET, 2/2/57 1P.M., CLOUD COVERAGE-CLEAR



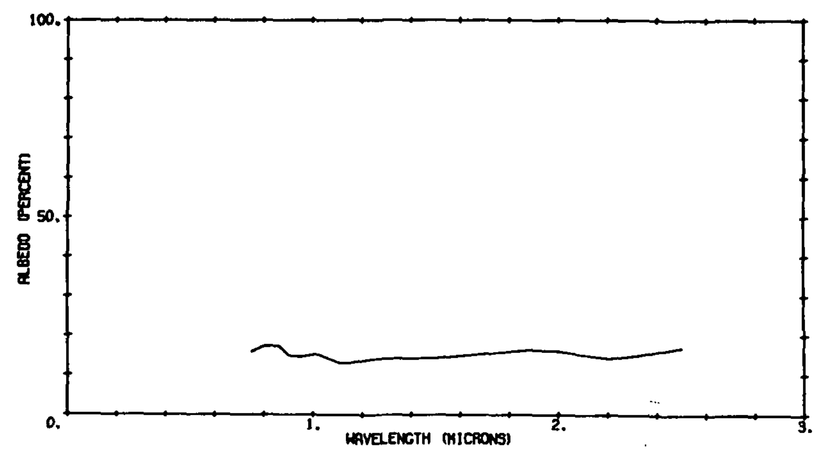
B01035 025

WATER AT 10,000 FT. 9/2/57 11A.M. CLOUD COVERAGE-CLEAR



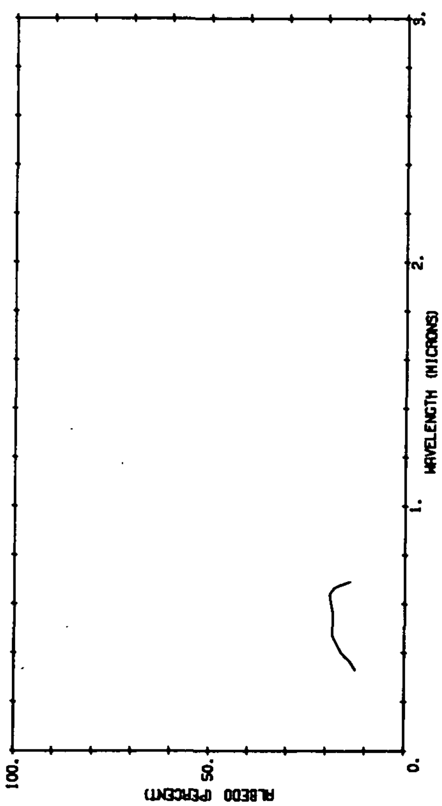
B01035 026

WATER AT 10,000 FT. 9/2/57 11A.M. CLOUD COVERAGE-CLEAR



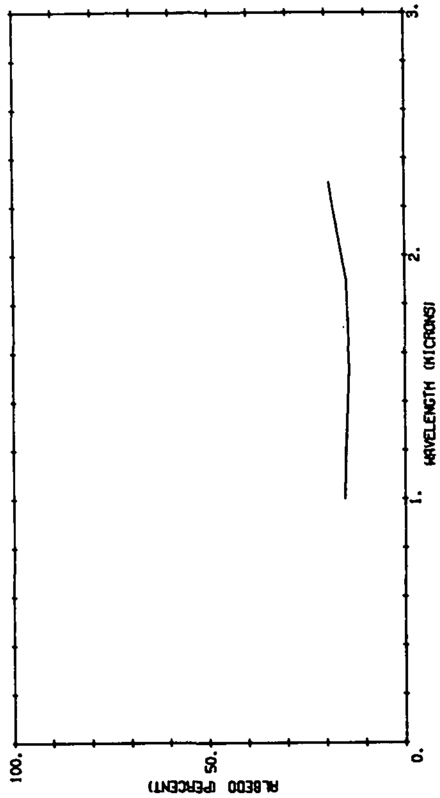
B01035 027

WATER AT 15,000 FT. 4/2/57 1P.M. CLOUD COVERAGE-CLEAR



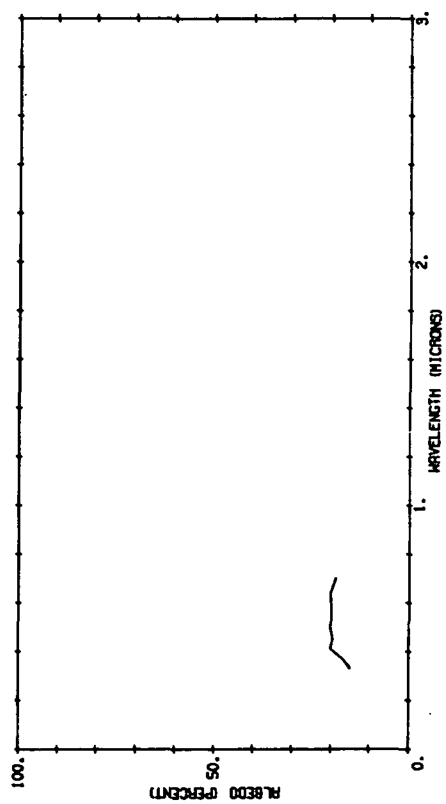
B01035 028

WATER AT 15,000 FT. 4/2/57 1P.M. CLOUD COVERAGE-CLEAR



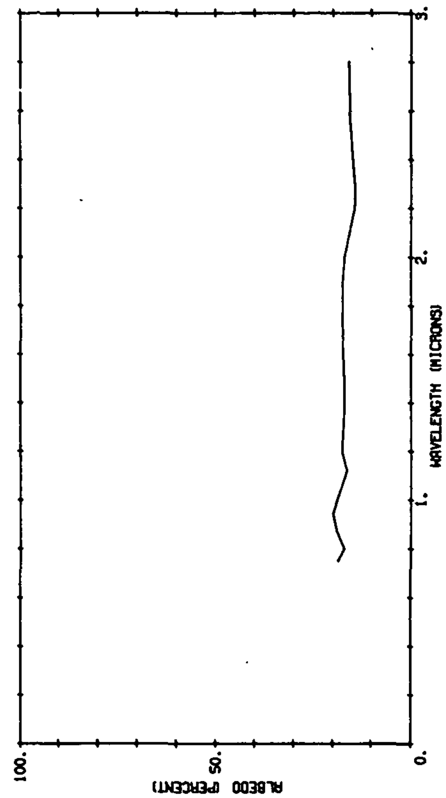
B01035 029

WATER AT 19,400 FT. 9/2/57 1P.M. CLOUD COVER-.2 AT 4 FT



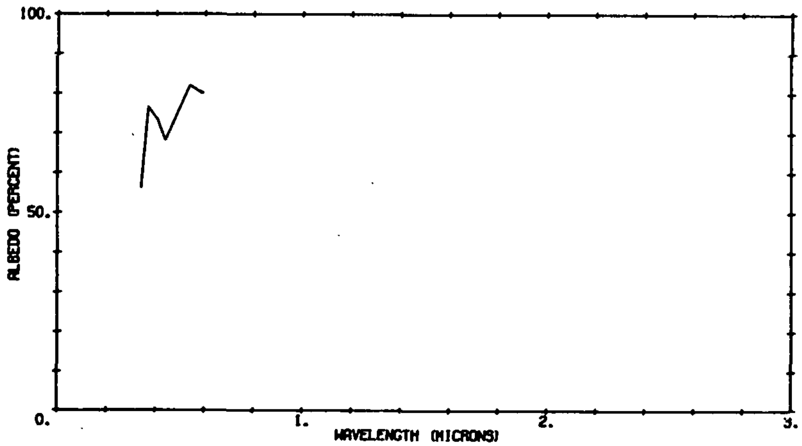
B01035 030

WATER AT 19,400 FT. 9/2/57 1P.M. CLOUD COVER-.2 AT 4 FT



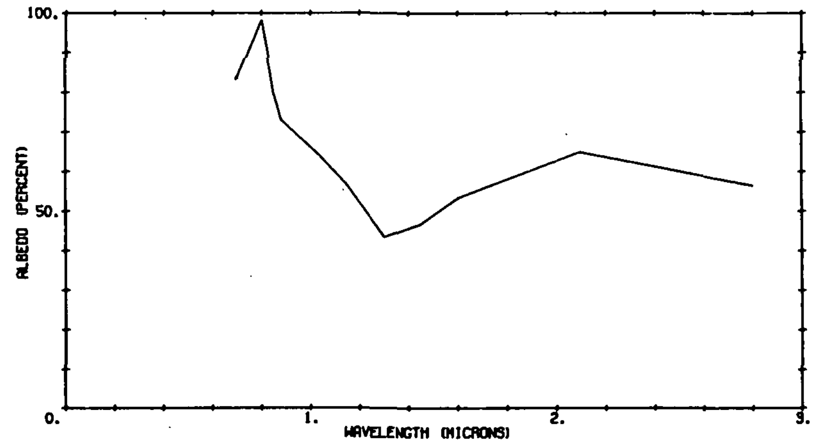
B01035 041

SNOW AT 500 FEET 3/3/57 11A.M. CLOUD COVERAGE-CLEAR



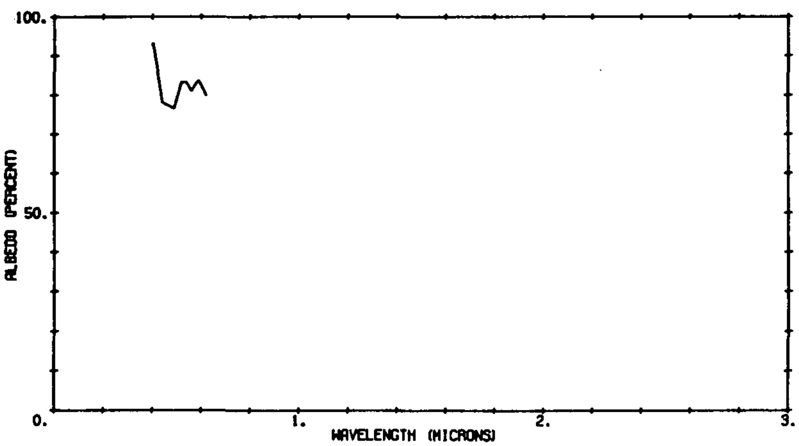
B01035 042

SNOW AT 500 FEET 3/3/57 11A.M. CLOUD COVERAGE-CLEAR



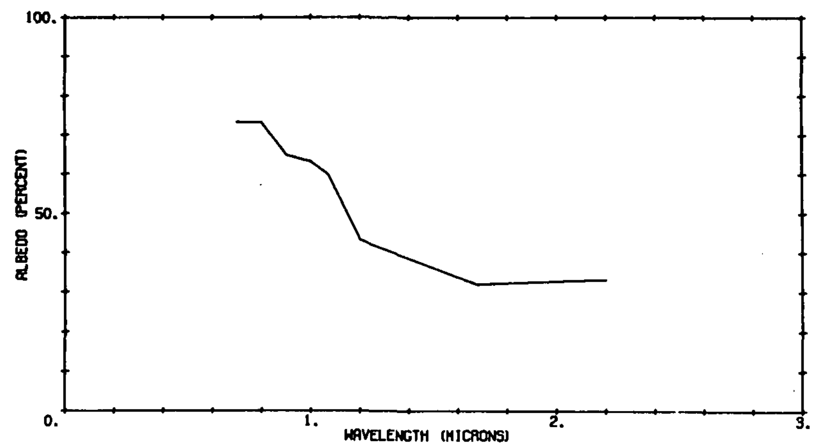
B01035 043

SNOW AT 5000 FT. 3/3/57 12P.M. CLOUD COVERAGE-CLEAR



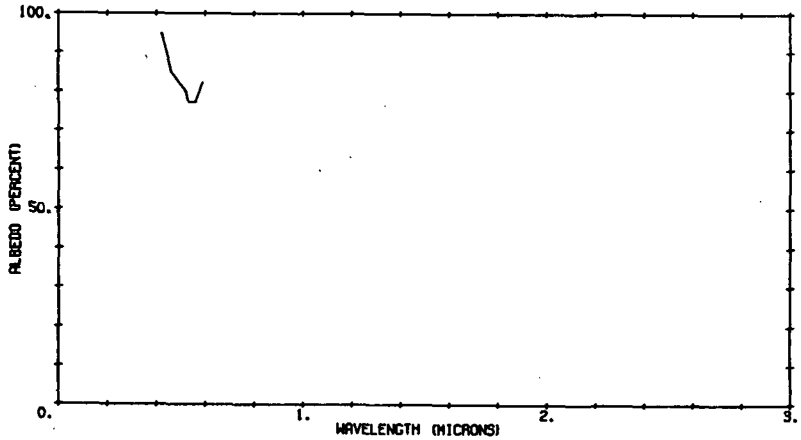
B01035 044

SNOW AT 5000 FT. 3/3/57 12P.M. CLOUD COVERAGE-CLEAR



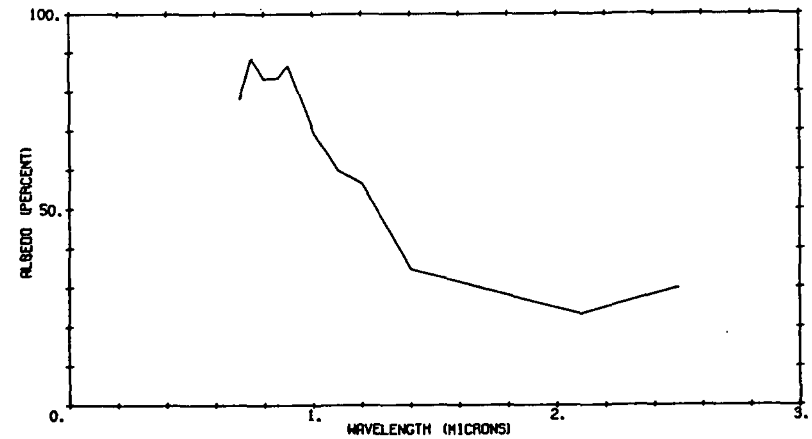
B01035 045

SNOW AT 10,000 FT.3/3/57 12P.M. CLOUD COVERAGE-CLEAR



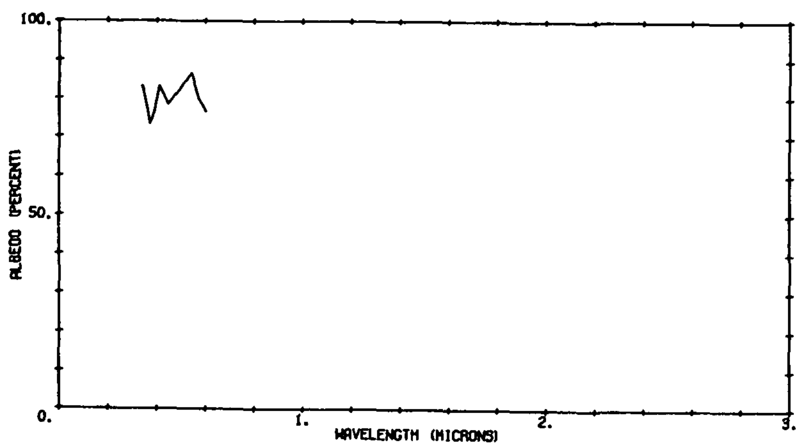
B01035 046

SNOW AT 10,000 FT.3/3/57 12P.M. CLOUD COVERAGE-CLEAR



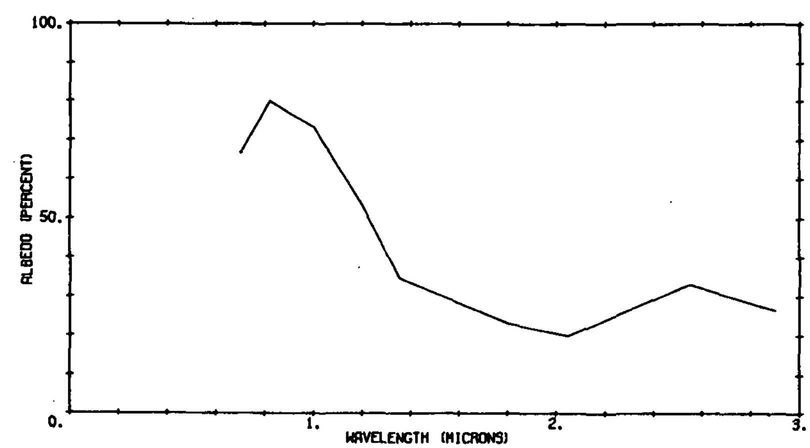
B01035 047

SNOW AT 13,000 FT.3/3/57 12P.M. CLOUD COVERAGE-CLEAR



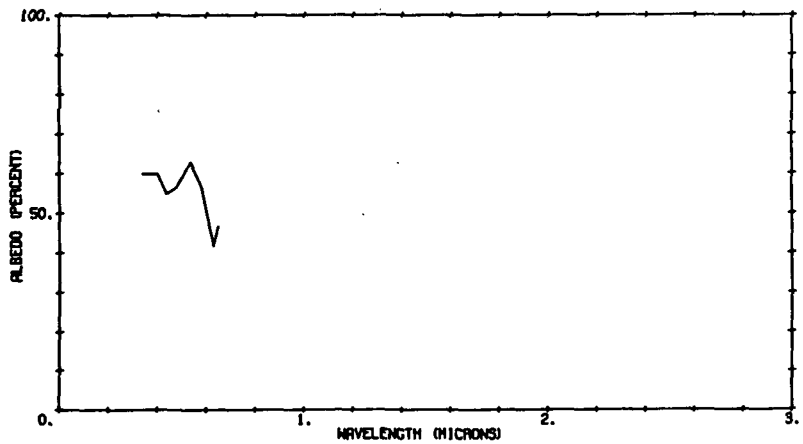
B01035 048

SNOW AT 13,000 FT.3/3/57 12P.M. CLOUD COVERAGE-CLEAR



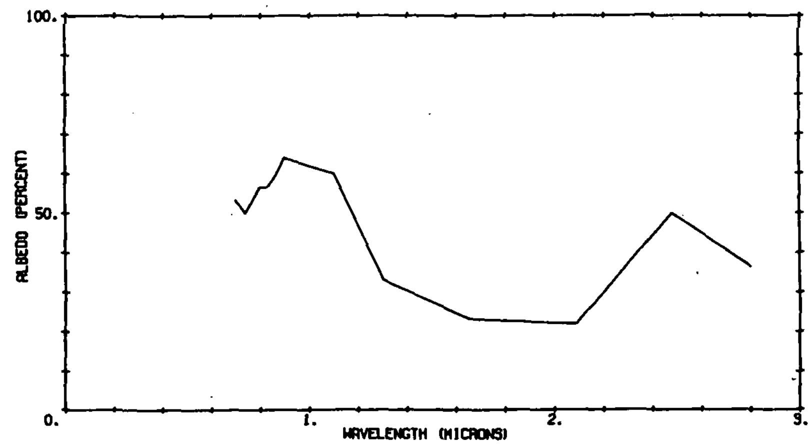
B01035 057

WOODED AREA COVERED WITH SNOW AT 12,000 FT. 3/3/57 1PM.CLEAR



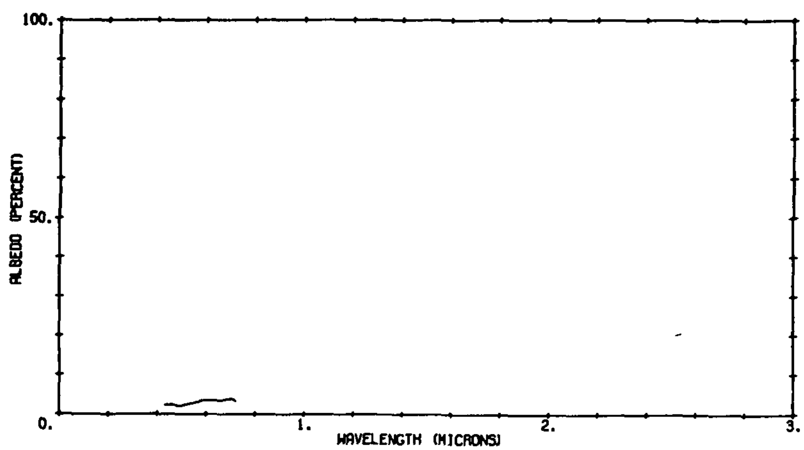
B01035 058

WOODED AREA COVERED WITH SNOW AT 12,000 FT. 3/3/57 1PM.CLEAR



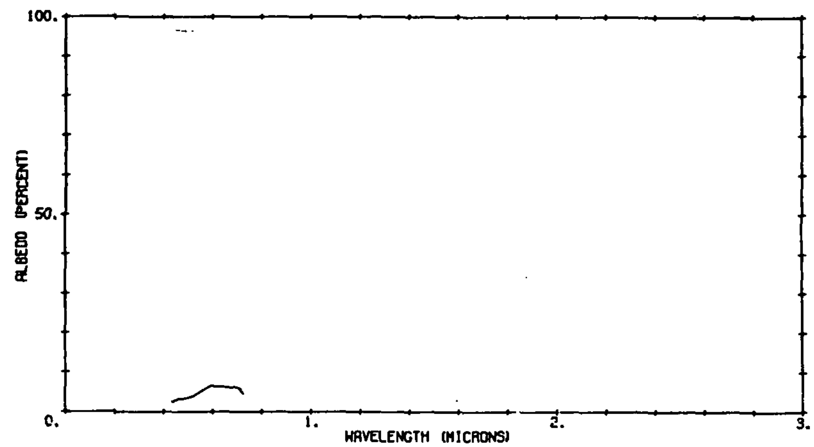
B01370 023

WATER WITH SUSPENDED MATERIAL (ORLANDO, FLORIDA)



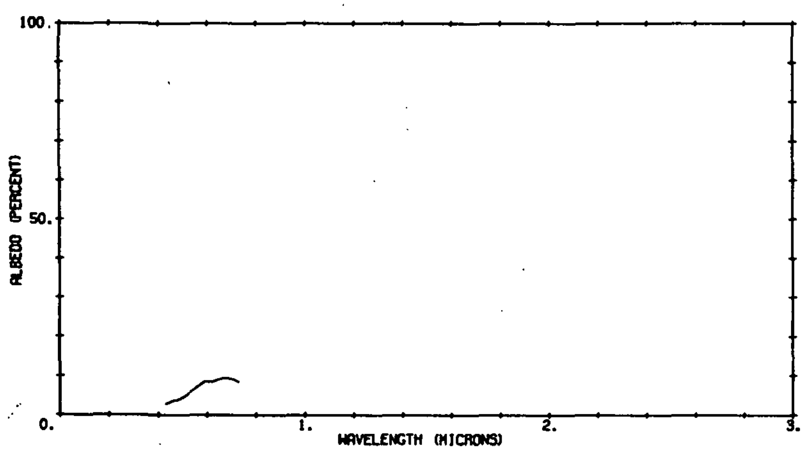
B01370 024

MUD, COVERED WITH WATER (ORLANDO, FLORIDA)



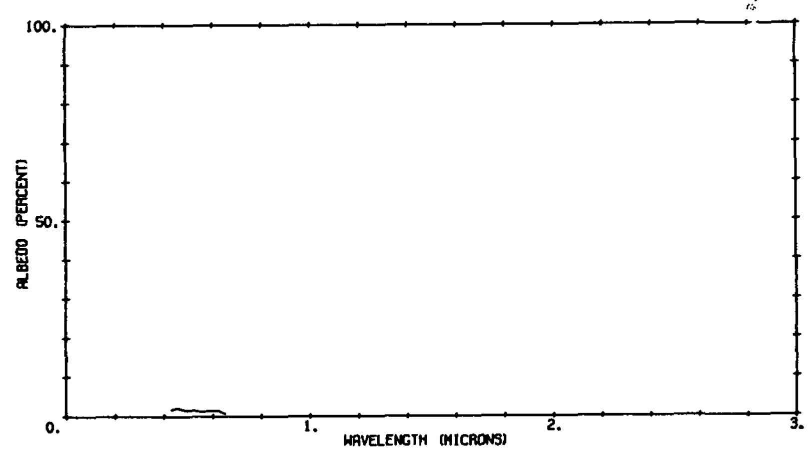
B01370 025

MUD, WET (ORLANDO, FLORIDA)



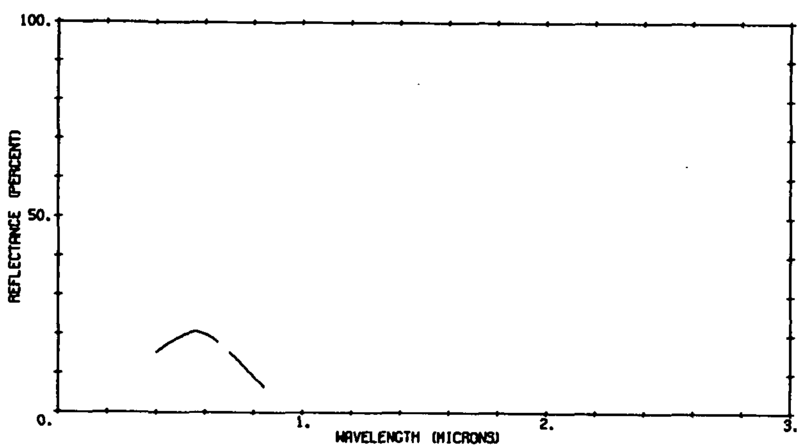
B01370 026

POND (ORLANDO, FLORIDA)



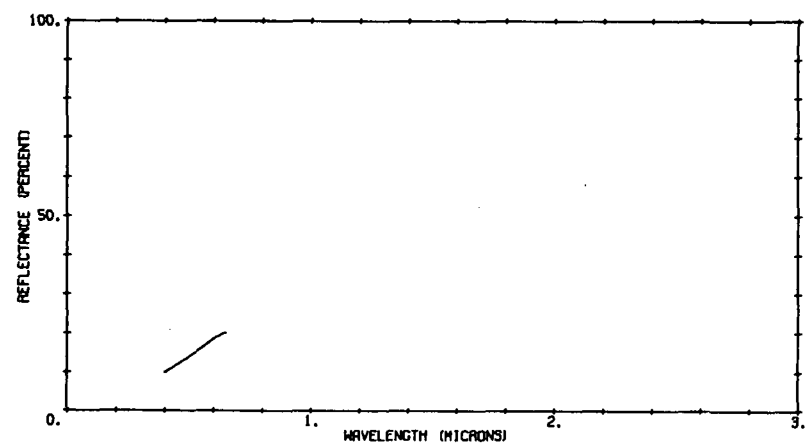
B03995 333

WATER IN RIVER, KUMAN, MUDDY, ALMOST PLUMR STEPPE



B03995 334

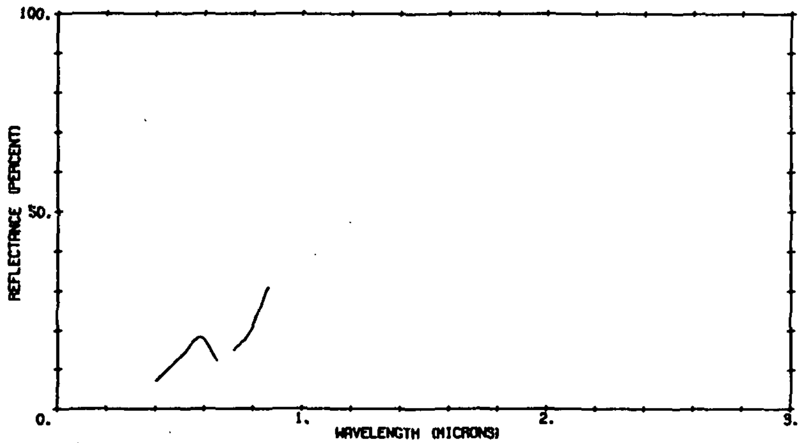
WATER IN RIVER, IN THE MOUNTAIN RIVER PZHCHAGAT, CLEAR, NORMAL



(F)BH 7

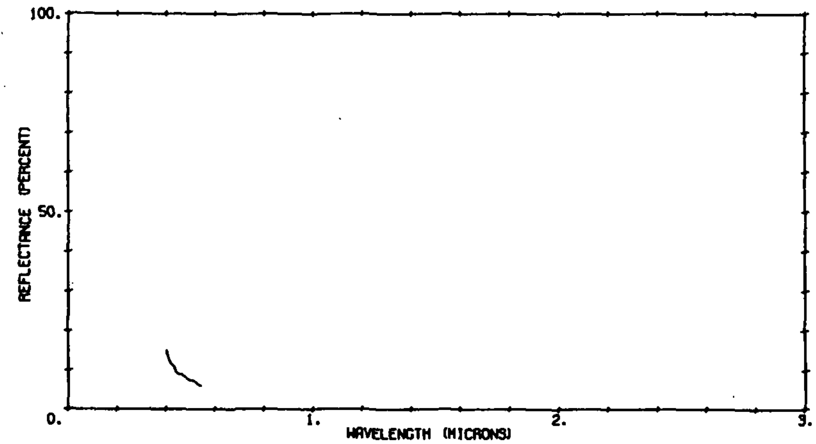
B03995 335

WATER IN RESERVIOR, VERY MUDDY,CHOCOLATE COLOR,NORMAL,DESERT



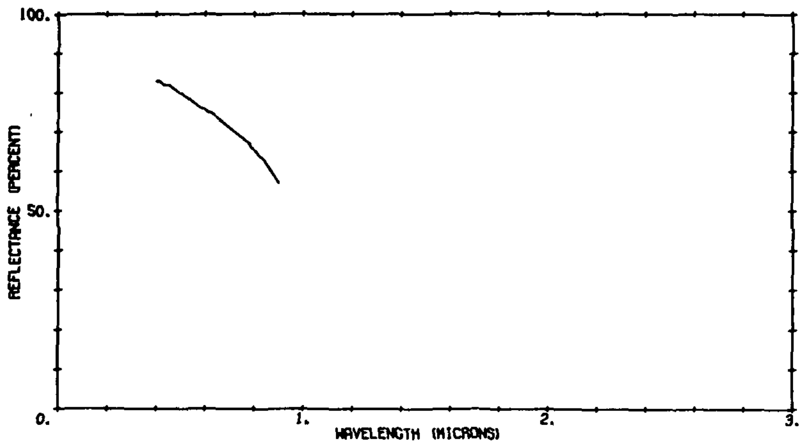
B03995 336

PONC, CLEAR WITH REFLECTION OF BLUE SKY, A=9' DEGREES,ANG.=4
5 DEGREES



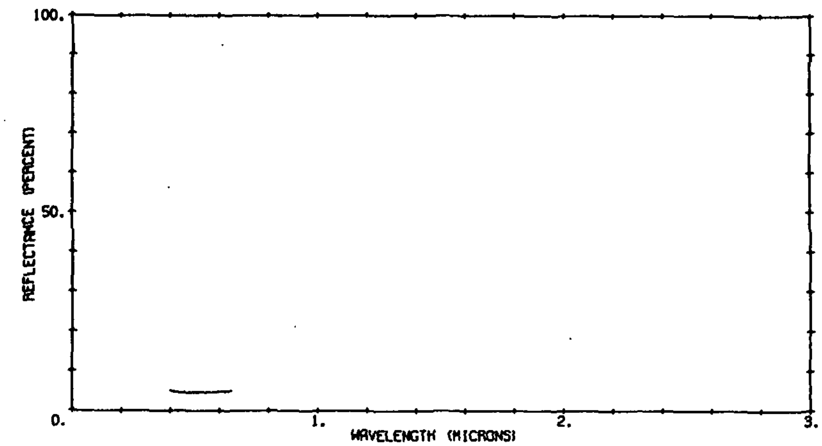
B03995 337

SNOW, FRESH, NORMAL N.F.B.



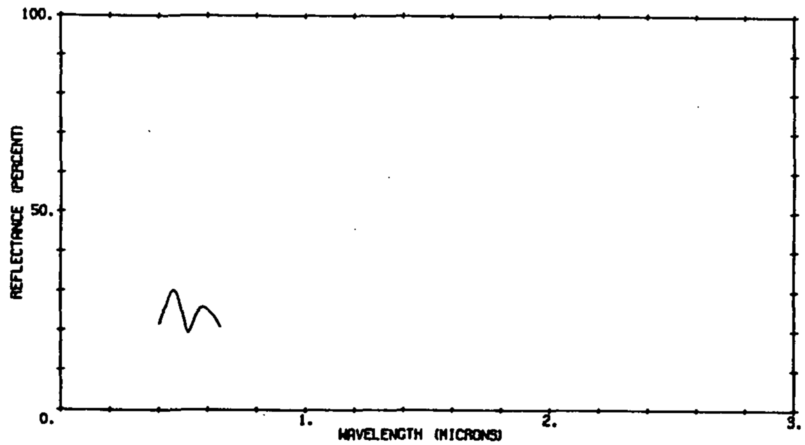
B03995 338

SNOW, DRY, WITH CRUST, A=? DEGREES, ANG.=2? DEGREES, N.F.B.



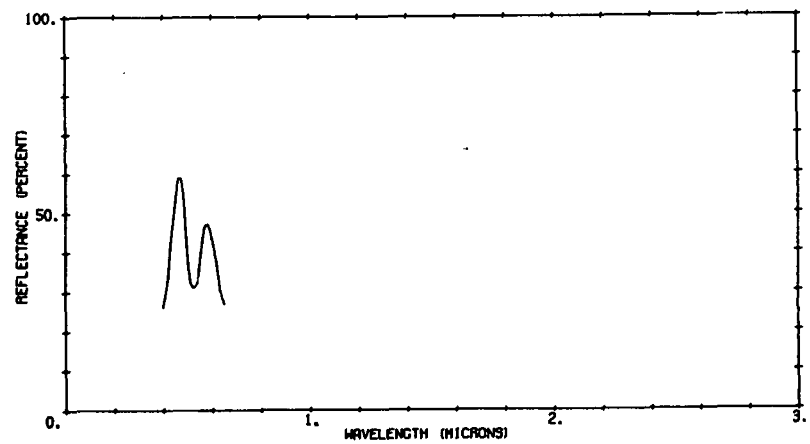
B03995 339

SNOW, DRY, WITH CRUST, A=? DEGREES, ANG.=45 DEGREES, N.F.R.



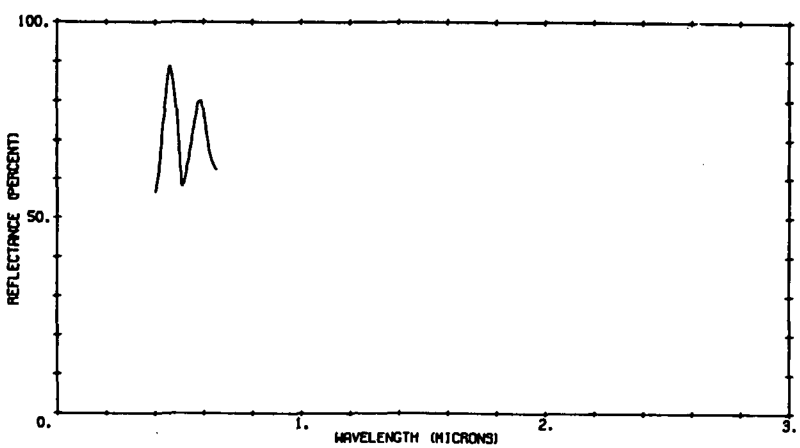
B03995 340

SNOW, DRY, WITH CRUST, A=? DEGREES, ANG.=6? DEGREES, N.F.R.



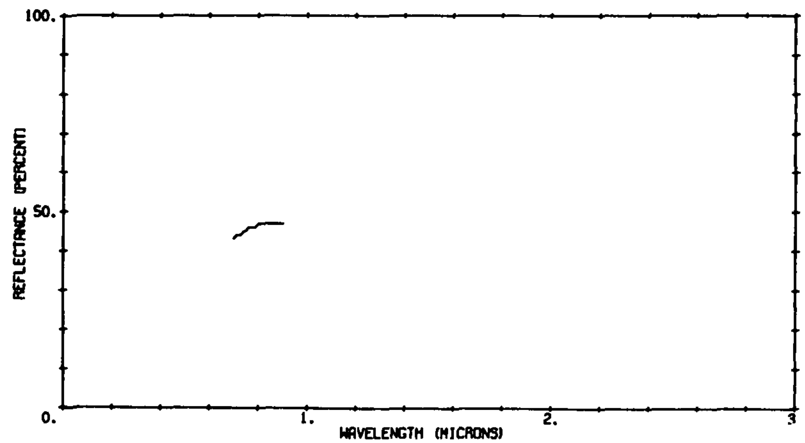
B03995 341

SNOW, DRY, WITH CRUST, A=? DEGREES, ANG.=83 DEGREES, N.F.R.



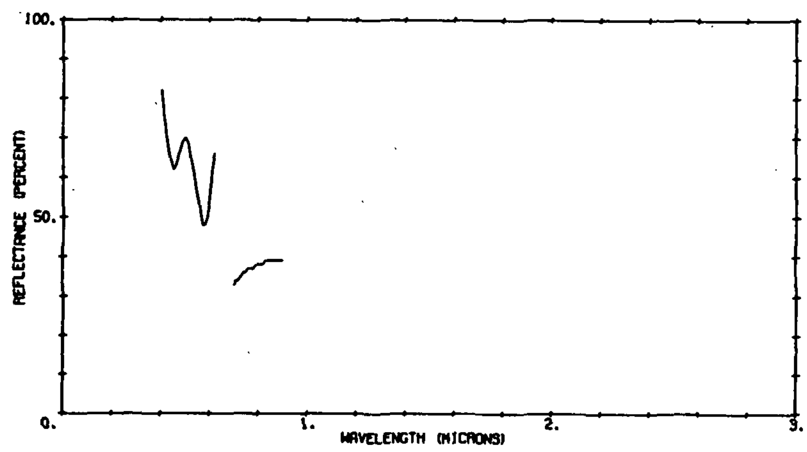
B03995 342

SNOW, DRY, WITH CRUST, A=93 DEGREES, ANG.=2? DEGREES, N.F.B.



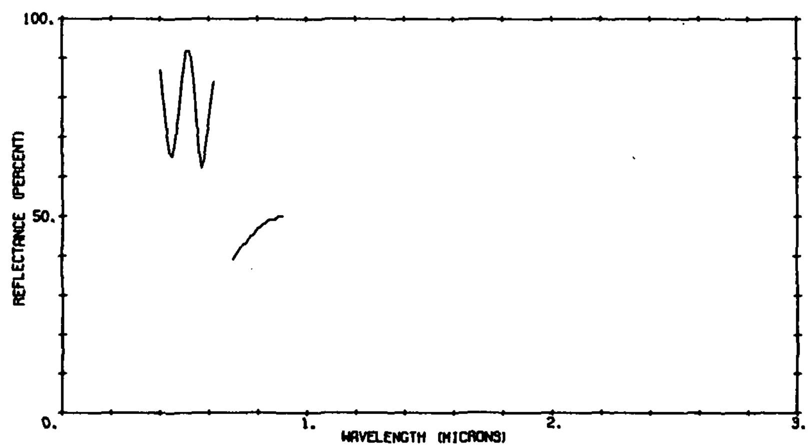
B03995 343

SNOW, DRY, WITH CRUST, A=90 DEGREES, ANG.=40 DEGREES, N.F.R.



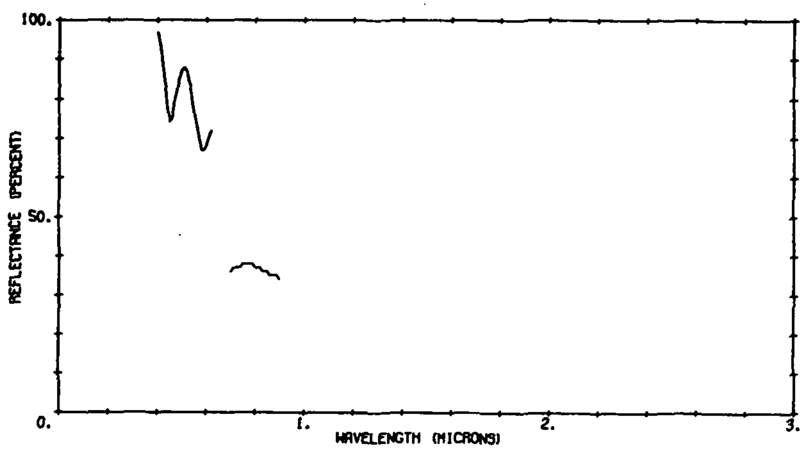
B03995 344

SNOW, DRY, WITH CRUST, A=90 DEGREES, ANG.=60 DEGREES, N.F.R.



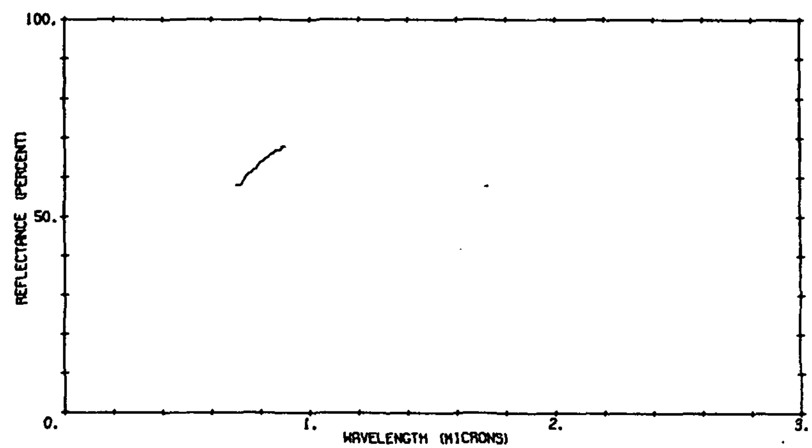
B03995 345

SNOW, DRY, WITH CRUST, A=90 DEGREES, ANG.=80 DEGREES, N.F.R.



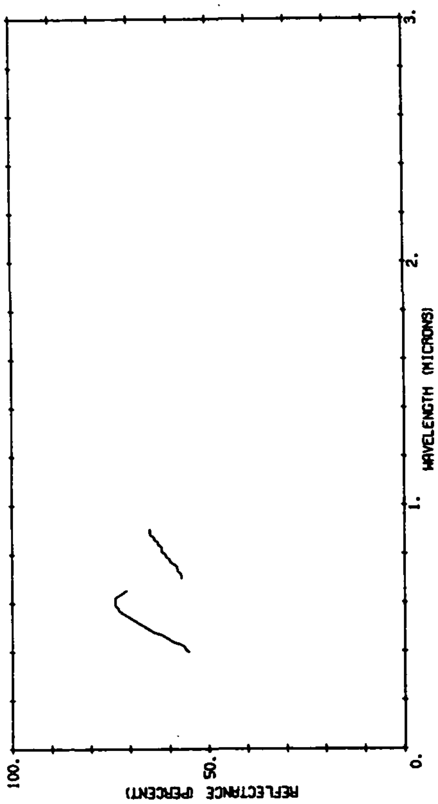
B03995 346

SNOW, DRY, WITH CRUST, A=180 DEGREES, ANG.=20 DEGREES, N.F.R.



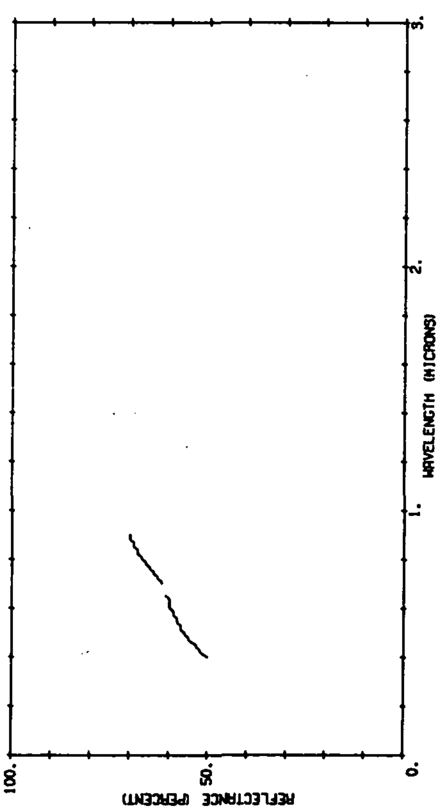
B03995 348

SNOW, DRY, WITH CRUST, A=180 DEGREES, ANG.=60 DEGREES, N
.F.B.



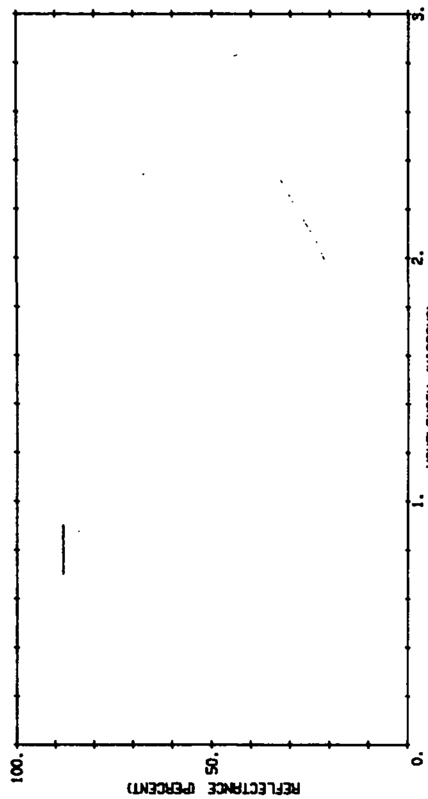
B03995 347

SNOW, DRY, WITH CRUST, A=180 DEGREES, ANG.=40 DEGREES, N
.F.B.



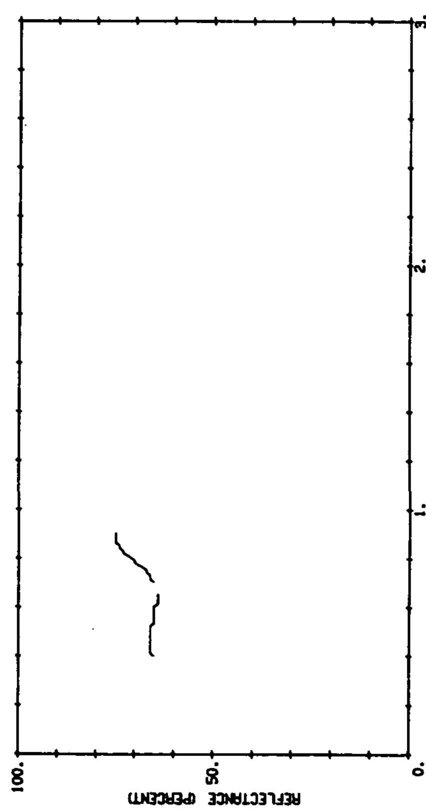
B03995 350

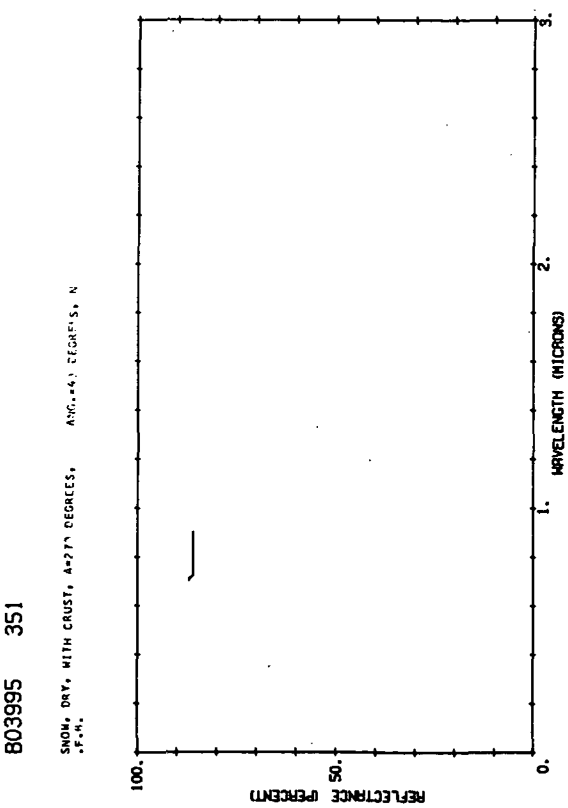
SNOW, DRY, WITH CRUST, A=270 DEGREES, ANG.=20 DEGREES, N
.F.R.

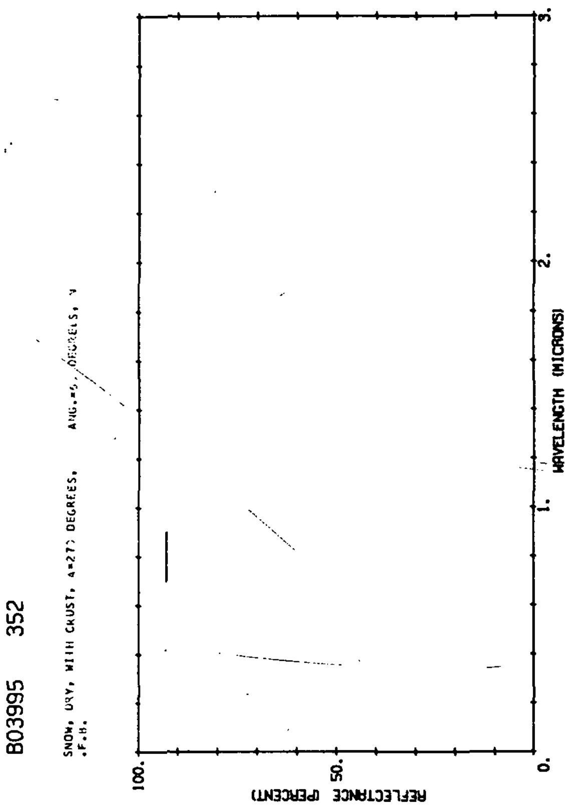


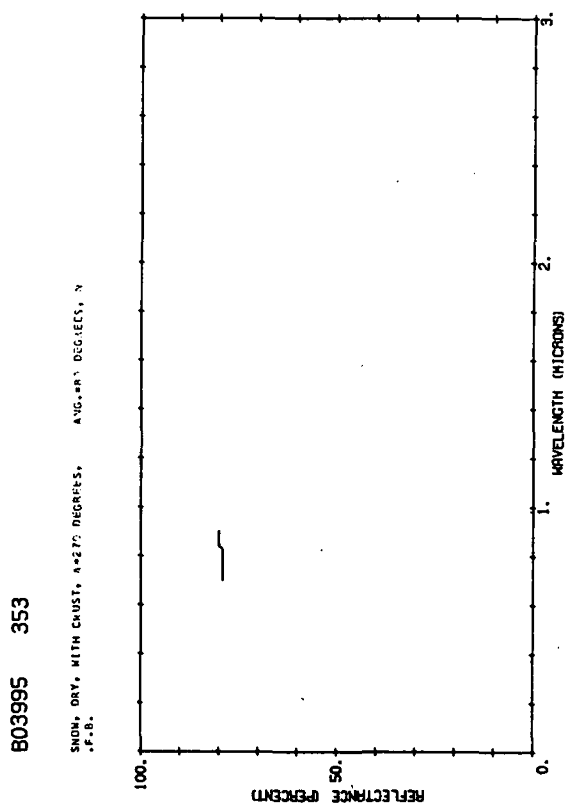
B03995 349

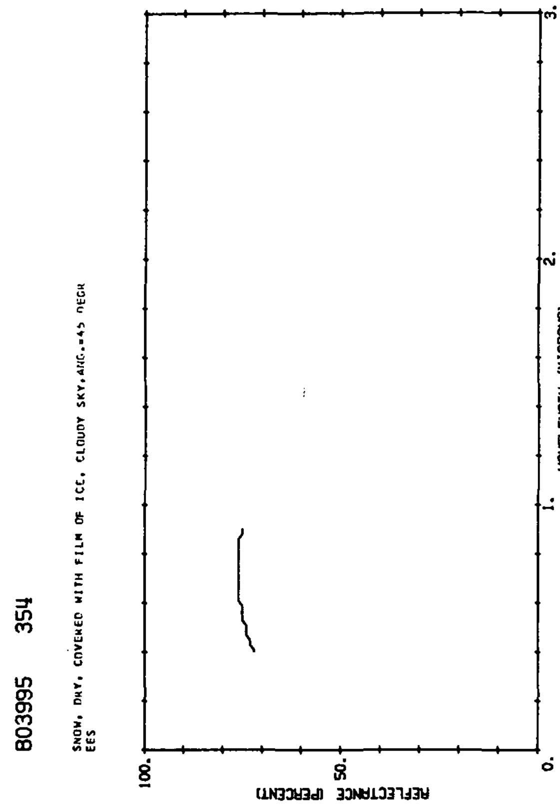
SNOW, DRY, WITH CRUST, A=180 DEGREES, ANG.=80 DEGREES, N
.F.B.




B03995 351
SNOW, DRY, WITH CRUST,
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.


B03995 352
SNOW, DRY, WITH CRUST,
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.


B03995 353
SNOW, DRY, WITH CRUST,
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.


B03995 354
SNOW, DRY, COVERED WITH FILM OF ICE, CLOUDY SKY,ANG.=45 DEGR
EES
REFLECTANCE (PERCENT)
WAVELENGTH (MICRONS)
100.
50.
0.
1.
2.
3.

Appendix I*
DATA INSTRUMENTATION TECHNIQUES

I.1. THEORY OF REFLECTANCE

The purpose of this discussion is to enable the user of this data compilation to consider the data in a proper perspective. The "reflectance" alone, for example, does not sufficiently describe the results of an experiment to allow the results to be used indiscriminately. One must have knowledge of the measuring instrument's characteristics, since they have measurable effect on interpretation of the output. Some important instrument parameters include spectral resolution, the solid angle of effective viewing, and characteristics of the radiation source.

Our present understanding of radiation theory does not permit an analytical description, in closed form, of the exact relationship between the radiation emitted by a source (whether natural or artificial) and the radiation received by a remote sensor after this radiation has been reflected by an object under surveillance. There are well known laws to describe the simple case of an electromagnetic wave incident upon a perfectly planar interface between two media. In this case, the reflected wave depends upon the radiation wavelength, the angle of incidence, and the physical properties (permittivity, permeability, and conductivity) of the two adjoining media. The laws governing such a case are sufficiently understood so that the refractive index and extinction coefficient of materials involved may be found by determining the reflection coefficients of the materials. For the more complicated case involving a surface with periodic or random surface irregularities, an analytic determination of the properties of the reflected electromagnetic field may only be approximated.

In the past 10 years, many papers have been published on scattering or reflection from rough surfaces. Many theories have been developed, but none is both general and rigorous at the same time. To perform reasonably simple numerical calculations on the basis of these theories, certain simplifying assumptions are introduced, usually including one or more of the following:

(1) The dimensions of scattering elements of the rough surface are either much smaller or much greater than the wavelength of the incident radiation.

(2) The radii of curvature of the scattering elements are much greater than the wavelength of the incident radiation.

(3) Shadowing or obscuration effects occurring at the surface may be neglected.

(4) Only the far field is to be considered.

(5) Multiple reflections may be neglected.

(6) Consideration is restricted to a particular model of surface roughness (e.g., sawtooth, sinusoidal protrusions of definite shape and in random position, with random variations in height given by their statistical distribution and correlation function).

*Most of the material in this appendix was developed under Air Force Contract AF 33(657)-10974 and was previously reported in Ref. [1].

Eq. (1) over all incident directions, which yields

$$L_r(\theta'_r, \phi'_r) = \int \rho' L_i(\theta'_i, \phi'_i) \cos \theta'_i \, d\omega'_i \qquad (2)$$

Also, by Helmholtz's reciprocity theorem, if the directions of the incident and reflected pencils are interchanged, the bidirectional reflectance is unchanged, i.e.,

$$\rho'(\theta'_1, \phi'_1; \theta'_2, \phi'_2; P; \lambda) = \rho'(\theta'_2, \phi'_2; \theta'_1, \phi'_1; P; \lambda) \qquad (3)$$

Since the optical constants of materials may change from point to point, bidirectional reflectance becomes a function of the location of dA. If it is then assumed that the surface can be described by $z' = f(x', y')$, the correct functional dependence for reflectance is

$$\rho'(\theta'_i, \phi'_i; \theta'_r, \phi'_r; P; \lambda; x', y', z')_{z'=f(x',y')}$$

Generally, the direction of the normal to dA is also a function of the location of dA on the surface of the object. Hence, even if the incident and reflected radiation have a constant direction with respect to the (x', y', z') coordinates, the angles (θ'_i, ϕ'_i) and (θ'_r, ϕ'_r) (taken with respect to the local normal) would be a function of location of the surface element dA. For convenience, a second, absolute coordinate system is usually introduced, viz., (x, y, z). The x-y plane of this system is coincident with the average value of $z' = f(x', y')$ along the surface A, and is, therefore, the "average" plane of the reflector. The normal to this average plane is parallel to the z axis. Instead of referring the incident and reflected radiation to the local coordinates, they are then referred to the absolute system, with θ as the polar angle and ϕ as the azimuthal angle. The bidirectional reflectance with respect to this system is

$$\rho'(\theta_i, \phi_i; \theta_r, \phi_r; P; \lambda; x, y)$$

Another type of reflectance commonly considered is the directional reflectance ρ_d which is a function of only one direction, either the incident or reflected direction. In the case where reflected power is integrated over a hemisphere and incident power is from a specific direction, directional reflectance is denoted by ρ_{di}. The incident power $d\Phi_i$ is

$$d\Phi_i = dL_i(\theta_i, \phi_i) \cos \theta_i \, d\omega_i \, dA \qquad (4)$$

and with Eq. (2),

$$dL_r = \rho' \frac{d\Phi_i}{dA} \qquad (5)$$

430

Since the reflected power $d\Phi_r$ is given by

$$d\Phi_r = dA \int_{2\pi} dL_r \cos\theta_r \, d\omega_r = d\Phi_i \int_{2\pi} \rho' \cos\theta_r \, d\omega_r \tag{6}$$

therefore,

$$\rho_{di}(\theta_i, \phi_i; P; \lambda; x, y) = \int_{2\pi} \rho' \cos\theta_r \, d\omega_r \tag{7}$$

When dA is uniformly illuminated from all directions (L_i = constant), the corresponding directional reflectance, ρ_{dr}, is defined as the ratio of the radiance reflected in a given direction to the incident radiance. To proceed as previously,

$$L_r = \int_{2\pi} \rho' L_i \cos\theta_i \, d\omega_i = L_i \int_{2\pi} \rho' \cos\theta_i \, d\omega_i$$

and, thus,

$$\rho_{dr}(\theta_r, \phi_r; P; \lambda; x, y) = \int_{2\pi} \rho' \cos\theta_i \, d\omega_i \tag{8}$$

From comparison of Eqs. (7) and (8),

$$\rho_{di}(\theta, \phi; P; \lambda; x, y) = \rho_{dr}(\theta, \phi; P; \lambda; x, y) = \rho_d \tag{9}$$

ρ_d is called directional reflectance.

I.2. INSTRUMENTATION

This section describes several types of instruments used to generate the optical data included in this compilation. An expression is derived for the "reflected quantity" measured by each type.

I.2.1. GENERAL ELECTRIC SPECTROPHOTOMETER [3]

A schematic diagram of this measurement apparatus is presented in Fig. 2. Monochromatic radiation from the source passes through a Nicol prism (N_1) and then through a Wollaston prism (W_1) oriented to N_1 at an azimuth angle α. The prism W_1 converts the radiation into two linearly polarized beams, the polarization of one of which is perpendicular to that of the other. The beams then pass through a rapidly rotating Nicol prism (N_2) and into the integrating sphere where, with the same angle of incidence, one impinges on a reference and the other on the sample materials. A detector looks into the sphere in a direction perpendicular to the plane of the two incident beams. The integrating sphere is coated with a diffuse reflector (MgO), the reflectance of which is assumed independent of polarization.

If f is used to denote the frequency of rotation of N_2, t to denote the time, the subscripts 1 and 2 to distinguish the beams incident on reference and sample respectively, the symbols $\perp$

Electromagnetic scattering theory has been used in the past to compute radiation backscatter from targets in the microwave region of the spectrum, where the radiation wavelength is much greater than the minute irregularities of the target surface, and where the conductivity of the target material is infinite. In the optical region, where materials have finite conductivity and the surface irregularities have a wide range in size relative to the radiation wavelength, present electromagnetic scattering theory is applicable to only a few special cases, so the only way to determine reflectance in this region for target and background objects is by experimentation.

One can arrive at the most general definition of reflectance ρ' (called bidirectional reflectance [2]) by considering an infinitesimal element of surface, dA, upon which radiation of infinitesimal solid angle $d\omega_i$ and radiance L_i is incident. Taking a coordinate system fixed with respect to dA, with polar angle θ' measured from the normal and azimuth angle ϕ' measured from a fixed line (see Fig. 1), the contribution to the reflected radiance, $dL_r(\theta'_r, \phi'_r)$, in the reflected pencil for the direction (θ'_r, ϕ'_r) is

$$dL_r(\theta'_r, \phi'_r) = \rho' L_i(\theta'_i, \phi'_i) \cos \theta'_i \, d\omega'_i \tag{1}$$

Generally, ρ' is a function of the incident and reflected directions (θ'_i, ϕ'_i and θ'_r, ϕ'_r respectively), the polarization (P), the wavelength (λ), and the optical parameters of the material on either side of the surface. Total radiance in a given reflected direction is obtained by integrating

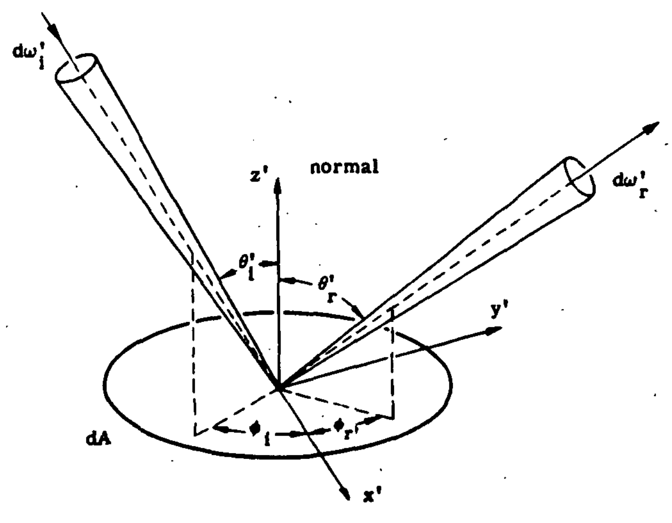


FIGURE 1. LOCAL COORDINATE SYSTEM FOR DETERMINING BIDIRECTIONAL REFLECTANCE

432

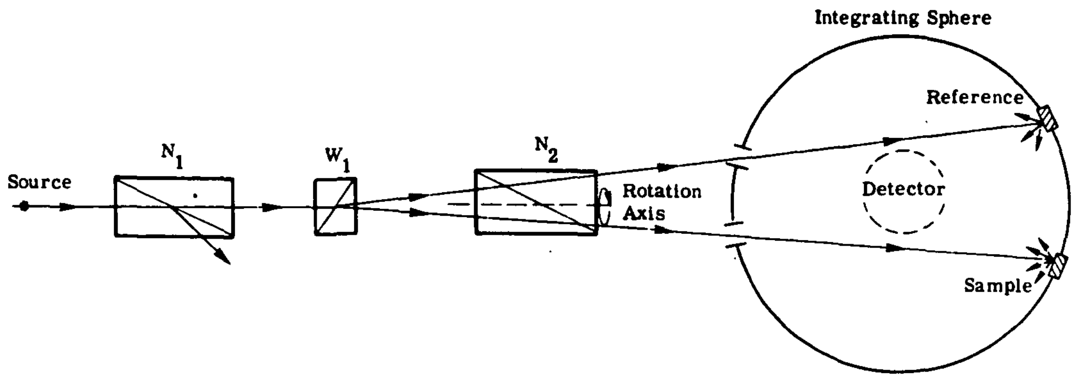


FIGURE 2. SCHEMATIC OF THE GENERAL ELECTRIC SPECTROPHOTOMETER

and || to represent the polarizations perpendicular to each other, and the superscripts i and r to represent incident and reflected radiation respectively, then the power at the detector (except for a factor dependent on the reflectance of the sphere) is

$$\Phi = \Phi_1^r + \Phi_2^r \tag{10}$$

The beams emerging from W_1 are linearly polarized and their powers given by

$$\begin{aligned} \Phi_1' &= \Phi_0 \sin^2 \alpha \\ \Phi_2' &= \Phi_0 \cos^2 \alpha \end{aligned} \tag{11}$$

where Φ_0 is the power from N_1. The prism N_2 passes that portion of the power polarized in a fixed direction, so that

$$\begin{aligned} \Phi_1^i &= \Phi_1' \sin^2 (2\pi ft) = \Phi_0 \sin^2 \alpha \sin^2 (2\pi ft) \\ \Phi_2^i &= \Phi_2' \cos^2 (2\pi ft) = \Phi_0 \cos^2 \alpha \cos^2 (2\pi ft) \end{aligned} \tag{12}$$

If it is assumed that the directional reflectance of the reference $\rho_{d,1}(\lambda)$ is independent of polarization,

$$\Phi_1^r = \rho_{d,1}(\lambda)\Phi_1^i = \rho_{d,1}(\lambda)\Phi_0 \sin^2 \alpha \sin^2 (2\pi ft) \tag{13}$$

If the polarization symbols || and $\perp$ are taken to refer to the polarization parallel to the directions in which beam 2 emerging from N_2 is maximum and minimum, respectively, then the power reflected from the sample is

$$\Phi_2^r = \Phi_0 \cos^2 \alpha \cos^2 (2\pi ft)\left[\rho_{d,2}(||, \lambda) \cos^2 (2\pi ft) + \rho_{d,2}(\perp, \lambda) \sin^2 (2\pi ft)\right] \tag{14}$$

433

The power at the detector is then*

$$\Phi = \Phi_0\left\{\rho_1 \sin^2 \alpha \sin^2 (2\pi ft) + \cos^2 \alpha \cos^2 (2\pi ft)\left[\rho_2(||, \lambda) \cos^2 (2\pi ft) + \rho_2(\perp, \lambda) \sin^2 (2\pi ft)\right]\right\} \quad (15)$$

Rearranging terms gives

$$\begin{aligned}\Phi = 1/2 &\left\{\rho_1(\lambda) \sin^2 \alpha + \cos^2 \alpha\left[\frac{3}{2}\rho^2(||, \lambda) + \frac{1}{2}\rho_2(\perp, \lambda)\right]\right\} \\ &- 1/2\left[\rho_1(\lambda) \sin^2 \alpha - \rho_2(||, \lambda) \cos^2 \alpha\right] \cos (4\pi ft) \\ &+ 1/8\left[\rho_2(||, \lambda) - \rho_2(\perp, \lambda)\right] \cos (8\pi ft) \cos^2 \alpha \end{aligned} \quad (16)$$

The a-c portion of the output from the detector, having a frequency of 2f, is fed to a motor which rotates N_1 so that it takes that position for which

$$\rho_1(\lambda) \sin^2 \alpha = \rho_2(||, \lambda) \cos^2 \alpha \quad (17)$$

A simple measurement of α allows $\rho_2(||, \lambda)$ to be computed from

$$\rho_2(||, \lambda) = \rho_1 \tan^2 \alpha \quad (18)$$

when the reflectance of the reference, $\rho_1(\lambda)$, is known. The directional reflectance ρ_2 is, of course, a function of the direction of incidence, and, therefore, the calculated value is correct only for that particular direction.

Since the incident beam is not infinitesimally narrow, it illuminates a finite, albeit small, area of the sample. Therefore, the computed directional reflectance of the sample is really the true reflectance averaged over the illuminated area,

$$\bar{\rho}_2(||, \lambda) = \frac{1}{A} \int_A \rho_2(||; \lambda; x, y)\, dx\, dy \quad (19)$$

where A is the illuminated area of the sample, and similarly for ρ_1. Hence, in terms of the reference $\bar{\rho}_1$, the reflectance of the sample is

$$\frac{\bar{\rho}_2(||, \lambda)}{\bar{\rho}_1(\lambda)} = \tan^2 \alpha$$

I.2.2. BECKMAN DK-2 SPECTROPHOTOMETER WITH REFLECTANCE ATTACHMENT

Figure 3 is an illustration of this measuring device. Monochromatic light is reflected from an oscillating plane mirror (M_1) alternately to one of two spherical mirrors (M_2 and

*The subscript d has been dropped.

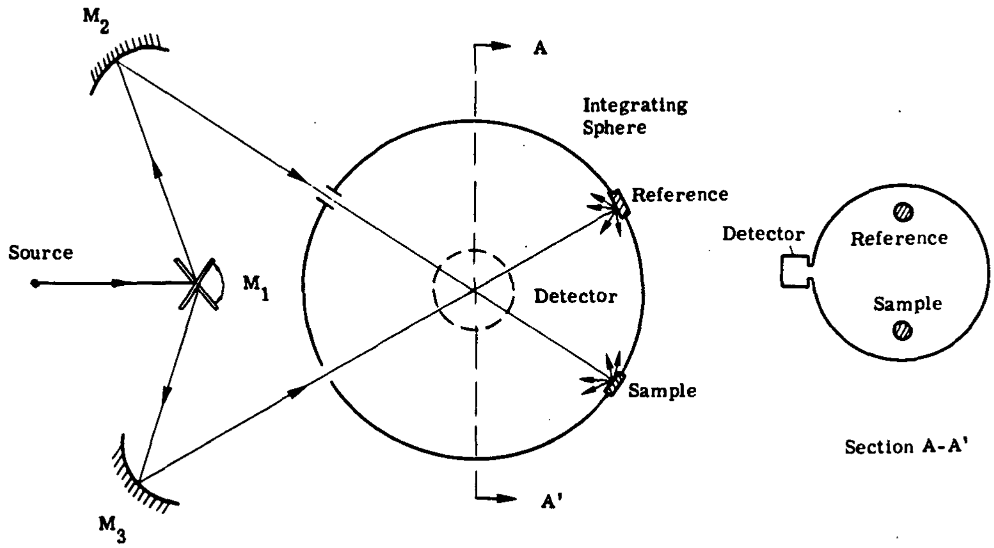


FIGURE 3. SCHEMATIC OF THE BECKMAN SPECTROPHOTOMETER WITH REFLECTANCE ATTACHMENT

M_3). M_1 is positioned in the focal planes of M_2 and M_3. Thus, the radiation is reflected alternately, with little divergence, onto the reference and the sample at normal incidence. The detector compares the reflected power from the reference and sample and gives the ratio of the two.

Because the monochromator is a prism instrument, the radiation incident on M_1 is slightly polarized. More polarization results from reflection from the plane and spherical mirrors. Radiation entering the integrating sphere is probably elliptically polarized. If the subscripts 1 and 2 are used for quantities referring to the reference and sample respectively, and $\rho_d(P, \lambda, n)$ is taken to represent the directional reflectance at normal incidence, wavelength λ, and polarization P, the reflected powers are

$$\begin{aligned} \Phi_1^r &= \rho_{d,1}(\lambda, n)\Phi_0 \\ \Phi_2^r &= \rho_{d,2}(P, \lambda, n)\Phi_0 \end{aligned} \tag{20}$$

where Φ_0 is the incident power of wavelength λ and polarization P. It is assumed that the reflectance of the reference is not polarization dependent.

Because the radiation is incident normal to the reflectors, that portion of the power which is specularly reflected will exit through the entrance ports undetected. If $\rho_s(P, \lambda, n)$ is taken as the specular reflectance for normal incidence, wavelength λ, and polarization P, then the specularly reflected powers are $\rho_{s,1}(\lambda, n)\Phi_0$ and $\rho_{s,2}(P, \lambda, n)\Phi_0$ for the reference and sample respectively. If the incident radiation had no divergence and filled the whole entrance port, none of the specularly reflected radiation would be detected. However, because of the divergence of the incident beam and the configuration of the equipment, only a fraction k of this radiation would be undetected. Therefore, the detected powers are

$$
\begin{aligned}
\Phi_1^r &= [\rho_{d,1}(\lambda, n) - k\rho_{s,1}(\lambda, n)]\Phi_0 \\
\Phi_2^r &= [\rho_{d,2}(P, \lambda, n) - k\rho_{s,2}(P, \lambda, n)]\Phi_0
\end{aligned}
\tag{21}
$$

The same value of k is used for both reference and sample because of symmetry. The value reported by the detector represents the ratio

$$\frac{\rho_{d,2}(P, \lambda, n) - k\rho_{s,2}(P, \lambda, n)}{\rho_{d,1}(\lambda, n) - k\rho_{s,1}(\lambda, n)} = \frac{\Phi_1^r}{\Phi_2^r}$$

Again, the indicated reflectances are averages over the illuminated areas.

I.2.3. COBLENTZ HEMISPHERE USED BY NEW YORK UNIVERSITY

This measurement apparatus uses a hemispherical specular reflector (see Fig. 4) with the sample and detector located a small distance from and diametrically opposite to the center of the sphere. Through an entrance port, well-collimated, monochromatic radiation becomes incident on the sample at a fixed angle. Because of imaging problems associated with the off-center location of the sample, the aperture of the detector should be larger than the sample to guarantee that most of the radiation reflected from the hemisphere is detected. With $L_i(\lambda; P_i; \theta_i, \phi_i)$ representing the radiance with wavelength λ and polarization P_i incident on the sample in the direction (θ_i, ϕ_i), the radiance reflected by the sample, L_r, is

$$L_r(\lambda; P_r; \theta_r, \phi_r) = \rho'(\lambda; P_i; \theta_r, \phi_r; \theta_i, \phi_i)L_i \cos \theta_i \, d\omega_r \tag{22}$$

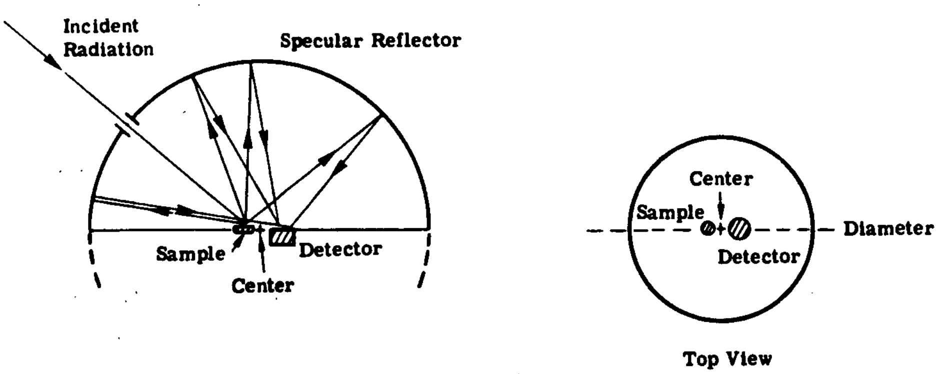


FIGURE 4. SCHEMATIC OF THE COBLENTZ HEMISPHERICAL REFLECTANCE ATTACHMENT USED BY NEW YORK UNIVERSITY

where the subscript r designates reflected radiation and ρ' is the bidirectional reflectance for incident polarization P_i. Given the directions of incidence and reflection, P_i, and λ, P_r may be determined.

If it can be assumed that the distance from the sample to the center of the sphere is very small compared to the radius of the sphere and that the area being illuminated is small, then the reflected radiance is approximately normally incident on the sphere. For normal incidence, the reflectance of the sphere, ρ_s, is independent of polarization of the incident radiation and depends only on its wavelength. The power Φ at the detector is, thus,

$$\Phi = \rho_s(\lambda)L_i \cos\theta_i \, d\omega_i A \int_{\omega_r=2\pi} \rho'(\lambda; P_i; \theta_r, \phi_r; \theta_i, \phi_i) \cos\theta_r \, d\omega_r \tag{23}$$

where N_i is taken as uniform across the illuminated area A, ω_r as the solid angle for reflection from the sample, and ρ' as the bidirectional reflectance averaged over A. From the definition for ρ_d,

$$\Phi = L_i \cos\theta_i \, d\omega_i A \rho_s(\lambda) \rho_d(\lambda; P_i; \theta_i, \phi_i) \tag{24}$$

By making two measurements, one with the sample and one with a reference having a directional reflectance $\rho_{d,1}$ which is known,

$$\frac{\rho_d(\lambda; P_i; \theta_i, \phi_i)}{\rho_{d,1}(\lambda; P_i; \theta_i, \phi_i)} = \frac{\Phi}{\Phi_1} \tag{25}$$

is obtained, where the power reflected from the reference and the reflectances are averaged over the illuminated areas.

Equation (24) represents the power incident in the plane of the detector. In reality, however, the acceptance angle of the detector, ω_d, is less than 2π, so the power received by the detector, Φ_{rec}, is given by

$$\Phi_{rec} = (\omega_d/2\pi)\Phi$$

At angles of grazing incidence in the plane of the detector, radiation is reflected by the detector and is strongly polarized. This radiation is reflected off the hemisphere and onto the sample. Therefore, there will be some error caused by multiple reflections, and these reflections will be more strongly polarized than the initial radiation from the monochromator.

I.2.4. PORTABLE SPECTROPHOTOMETER USED BY USAERDL

This instrument is shown in Fig. 5. White, unpolarized radiation from the source is reflected from a plane mirror (M_1) onto the sample. Radiation reflected from the sample is focused onto the detector aperture by a spherical mirror (M_2). The detector is located in the focal plane

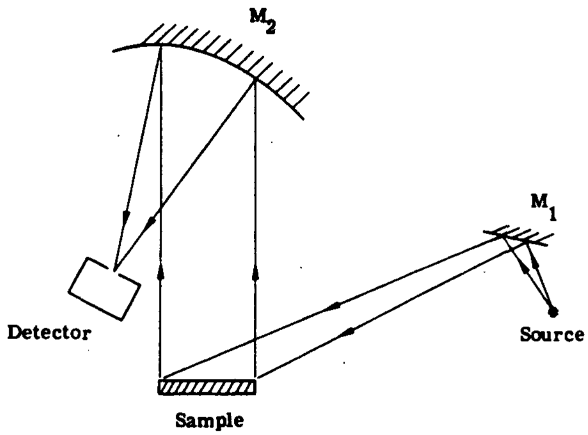


FIGURE 5. SCHEMATIC OF THE USAERDL PORTABLE SPECTROPHOTOMETER

of M_2 and thus receives only the radiation reflected normally from the sample. In practice, the detector is a monochromator, so only radiation at a particular wavelength λ is sensed. The source and M_1 can be moved about to give different angles of incidence on the sample. As a result of reflection from M_1 the radiance incident on the sample is probably partially polarized.

The spectral radiance incident on an area dA of the sample located at (x, y) is $L_i(\lambda; P; \theta_i, \phi_i; x, y)$, where P is the polarization for the incident direction (θ_i, ϕ_i). For this particular configuration, (θ_i, ϕ_i) is determined by (x, y). The spectral power reflected normally ($\theta_r = 0°$) by each dA is $d\Phi$:

$$d\Phi = dA L_i(\lambda, P) \left[\int_{\Delta\omega_i} \rho'(\lambda; P; \theta_i, \phi_i; n; x, y) \cos \theta_i \, d\omega_i \right] d\omega_r \tag{26}$$

where ρ' is the spectral bidirectional reflectance for radiation of polarization P which is incident from (θ_i, ϕ_i) on the area at (x, y) and reflected normally (indicated by the symbol n); $\Delta\omega_i$ is the solid angle of the source as seen from the sample, and it is assumed that L_i is constant* in each $\Delta\omega_i$. The total power Φ reflected normally by the sample (of area A) is

$$\Phi = L_i(\lambda, P) \left[\int_A \int_{\Delta\omega_i} \rho'(\lambda; P; \theta_i, \phi_i; n; x, y) \cos \theta_i \, d\omega_i \, dA \right] d\omega_r \tag{27}$$

*It has been assumed that $\Delta\omega_i$ is small enough so that a constant, meaningful polarization can be associated with the pencil of radiation.

For a reference with bidirectional reflectance ρ_r' that is independent of position and polarization, the detected power Φ is

$$\Phi' = L_i(\lambda, P)A\left[\int_{\Delta\omega_i} \rho_r'(\lambda;\ \theta_i, \phi_i;\ n) \cos\theta_i\, d\omega_i\right] d\omega_r \tag{28}$$

The ratio of the power detected from the sample to that from the reference is

$$\frac{\Phi}{\Phi'} = \frac{\int_{\Delta\omega_i} \bar{\rho}'(\lambda;\ P;\ \theta_i, \phi_i;\ n) \cos\theta_i\, d\omega_i}{\int_{\Delta\omega_i} \rho_r'(\lambda;\ \theta_i, \phi_i;\ n) \cos\theta_i\, d\omega_i} \tag{29}$$

where $\bar{\rho}$ is the average of ρ' over the area A, i.e.,

$$\bar{\rho}' = \frac{1}{A}\int_A \rho'\, dA \tag{30}$$

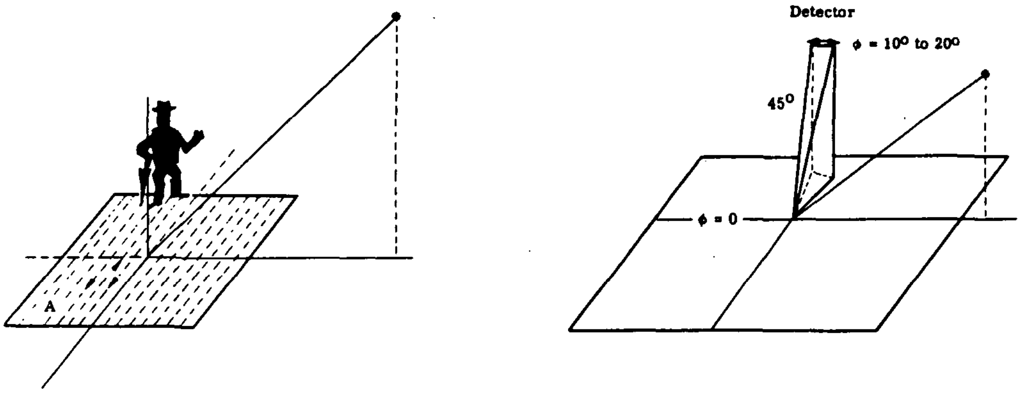
With $\Delta\omega_i$ so small that quantities may be considered constant throughout it, Eq. (29) becomes

$$\frac{\bar{\rho}'(\lambda;\ P;\ \theta_i, \phi_i;\ n)}{\rho_r'(\lambda;\ \theta_i, \phi_i;\ n)} = \frac{\Phi}{\Phi'} \tag{31}$$

In practice, the beam incident on the sample in this case is divergent. Since reflectance for most objects exhibits angular dependence, and since a divergent beam represents a range of incidence angles, it intuitively appears that the divergence angle will affect the final reflectance value.

I.2.5. KRINOV'S FIELD MEASUREMENTS [4]

The methods described in this section were used for field measurements with the sun and a clear sky as the radiation source. The measurement procedure varied depending upon whether the surface measured was horizontal or vertical. For horizontal surfaces, the detector was oriented in one of two positions: looking directly downward or looking downward at 45^{o} to the vertical. To establish a reference system for further discussion, all azimuth values are relative to the sun which is defined to be at an azimuth of 180^{o}; angles are considered positive when measured clockwise from the zero-azimuth line. When looking downward, the detector was either moved back and forth along the 90^{o}-270^{o} line over a large area (cf. Fig. 6a) or rotated 5^{o} to 10^{o} about a vertical axis coincident with its viewing direction (cf. Fig. 6b). In the first case, when the detector was moved back and forth over a large area of the ground being observed, the instrument was always oriented normal to the ground. In effect, the measurement was bidirectional if it can be assumed that all the incident radiation emanates from the sun. Under this assumption, $\rho'(\theta_i, \phi_i;\ \theta_r, \phi_r) = \rho'(\theta_{sun}, 180;\ 0, 0)$. This measurement is



(a) Horizontal surfaces: man walks over area A to be measured with the spectrograph; spectrograph is oriented normal to ground and looking downward for as much as 30 min.

(b) Horizontal surfaces: $\theta = 45^{o}$: $\phi = 270^{o}$: spectrograph rotated 10 to 20^{o} in azimuth.

FIGURE 6. SCHEMATIC OF MEASUREMENT CONFIGURATION USED BY KRINOV

integrated over the area of the ground observed. In the second case, the spectrograph was mounted on a tripod and directed at the sample at an angle of 45^{o} from the normal and an azimuth of 270^{o}. The spectrograph was then rotated on the tripod through an azimuth of 10^{o} to 20^{o}. When measuring vertical surfaces, i.e., trees, cliffs, or walls, the spectrograph was directed horizontally or slightly upward at the surface and at azimuths of 45^{o} or 315^{o}, and the instrument was then also rotated through a small azimuth.

Because the incident radiation comes from the sun and clear sky, the incident spectral radiance is very dependent on angle and not quite unpolarized (particularly in the blue region of the spectrum): $L_i(\lambda; P_i; \theta_i, \phi_i)$, with (θ_i, ϕ_i) the direction of incidence and P_i the polarization. Also, the time of day, season, and atmospheric condition act as variables. $d\Phi_s$ is the spectral power reflected by a surface element dA and into the rather large solid angle ω_D which subtends the detector:

$$d\Phi_s(\lambda) = dA \int_{\omega_D} d\omega_D \int_{\omega_i=2\pi} \rho'(\lambda; P_i; \theta_i, \phi_i; \theta_r, \phi_r) L_i(\lambda; P_i; \theta_i, \phi_i) \cos\theta_i \, d\omega_i \qquad (32)$$

where (θ_r, ϕ_r) is the direction of reflectance, ω_i the solid angle of incidence, and ρ' the bidirectional reflectance. The recorder for this system is photographic film, hence the system records energy. Assuming the detector views an area A at any time and scans at a constant rate over a time T, and that L_i is independent of time, then the spectral energy reflected by the sample, $Q_s(\lambda)$, is

$$Q_s(\lambda) = TA \int_{\omega_D} d\omega_D \int_{\omega_i=2\pi} \bar{\rho}'(\lambda; P_i; \theta_i, \phi_i; \theta_r, \phi_r) L_i(\lambda; P_i; \theta_i, \phi_i) \cos\theta_i \, d\omega_i \qquad (33)$$

where $\bar{\rho}'$ is ρ' averaged over the scanned area A_s, i.e.,

$$\bar{\rho}' = \frac{1}{A_s}\int_{A_s} \rho' \, dA$$

The sample can be replaced by a reference the reflectance of which, ρ'_r does not vary with position, and the film exposed for a time T without scanning. The reflected spectral energy $Q_R(\lambda)$ is then

$$Q_R(\lambda) = TA\int_{\omega_D} d\omega_D \int_{\omega_i=2\pi} \rho'_r(\lambda;\, P_i;\, \theta_i,\, \phi_i;\, \theta_r,\, \phi_r) L_i \cos\theta_i \, d\omega_i \tag{34}$$

A comparison of $Q_s(\lambda)$ and $Q_R(\lambda)$ may then be made.

For a second case referred to above, the results are the same if A_s is set equal to A, since it may be assumed that A is imaged onto a small area of the film and the average of $Q_s(\lambda)$ over this small area is taken. With the detector pointed downwards at 45° to the vertical and at an azimuth of 90° or 225° the results are obtained as shown with appropriate changes in θ_r and ϕ_r. Similar equations may be derived for vertical surfaces.

I.2.6. HOHLRAUM REFLECTANCE ATTACHMENT

This interesting apparatus for determining spectral reflectance is shown in Fig. 7. It consists of a blackbody cavity with a viewing port. The viewing port is small enough so that the

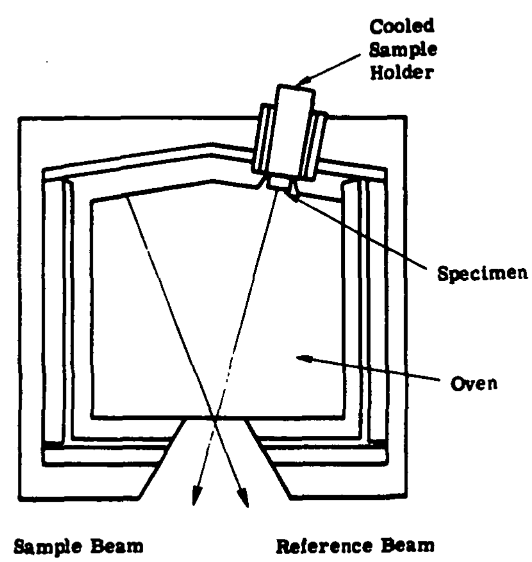


FIGURE 7. SCHEMATIC OF THE HOHLRAUM REFLECTANCE ATTACHMENT

radiation in the cavity closely approximates the blackbody case, and the portions of the inner wall visible through the port occupy only a small solid angle. The sample is water cooled and is oriented with its normal at an angle of 13^o to the viewing direction. If dA is again taken to represent the area of the sample viewed and ρ' to represent the bidirectional reflectance, the spectral power Φ_r reflected by the sample through the viewing port is

$$\Phi_r(\lambda) = dA\,L_r(\lambda)\cos(13^o)\,d\omega_r = d\Sigma\,d\omega_s L_r(\lambda) \tag{35}$$

where $L_r(\lambda)$ is the reflected spectral radiance, $d\omega_r$ the solid angle subtended by the viewing port at the sample, $d\Sigma$ the area of the detector (considered small), and $d\omega_s$ the solid angle subtended by the sample at the detector ($d\omega_s$ is considered normal to $d\Sigma$).

$$L_r(\lambda) = \int_{\omega_i} \rho'(\lambda;\,P_i;\,\theta_i,\,\phi_i;\,\theta_r,\,\phi_r) L_i(\lambda)\cos\theta_i\,d\omega_i \tag{36}$$

where $L_i(\lambda)$ is the incident spectral radiance, (θ_i, ϕ_i) the incident direction, ω_i the angle subtended at the sample by the entrance to the sample holder, and P_i the polarization of the incident radiation. The incident radiation is blackbody type and hence unpolarized; furthermore, the incident spectral radiance is a constant. Therefore,

$$\Phi_r(\lambda) = d\Sigma\,d\omega_s L_i(\lambda) \int_{\omega_i} \rho'(\lambda;\,P_i;\,\theta_i,\,\phi_i;\,13^o,\,\phi_r)\cos\theta_i\,d\omega_i \tag{37}$$

Next, the detector is moved to view a flat area dA of the cavity wall far from the sample holder. The resulting spectral power, Φ_w, there is

$$\Phi_w(\lambda) = dA\,d\omega_w L_i(\lambda)\cos\theta_w = d\Sigma\,d\omega_s L_i(\lambda) \tag{38}$$

where θ_w is the angle between the viewing direction and the normal to the wall, and $d\omega_w$ is the solid angle subtended by the viewing port at the area dA on the wall. The ratio of the spectral powers detected is

$$\frac{\Phi_w(\lambda)}{\Phi_s(\lambda)} = \int_{\omega_i} \rho'(\lambda;\,P_i;\,\theta_i,\,\phi_i;\,13^o,\,\phi_r)\cos\theta_i\,d\omega_i \tag{39}$$

Hence, the detector can be interpreted as giving the spectral bidirectional reflectance for unpolarized light, integrated over the projected solid angle of the source (as seen by the sample). Since it was assumed that the detector viewed only a very small area, dA, of the sample, the bidirectional reflectance appearing under the integral applies only to that area. In some instances, the sample has been placed at the wall of the Hohlraum cavity instead of further into the sample holder. The ratio of powers detected is then

$$\frac{\Phi_w(\lambda)}{\Phi_s(\lambda)} = \int_{\omega_i=2\pi} \rho'(\lambda; P_i; \theta_i, \phi_i; 13^o, \phi_r) \cos \theta_i d\omega_i = \rho_d(\lambda; P_i; 13^o, \phi_r)$$

Once again, the reflectance measured is an average over the illuminated area.

I.2.7. DETROIT ARSENAL REFLECTANCE MEASUREMENTS [5]

The measurements reported herein from the Detroit Arsenal were made with a Perkin-Elmer Recording Spectrometer and a Coblentz hemispherical reflectance attachment. Figure 8 is a schematic diagram of the measurement apparatus. Basically, the incident radiation, which is very nearly monochromatic, is focused on the sample through a small hole in the hemisphere. The sample is located at a small distance from the sphere's center. Energy reflected by the sample in any direction is re-reflected by the gold-coated hemisphere (a specular reflector)

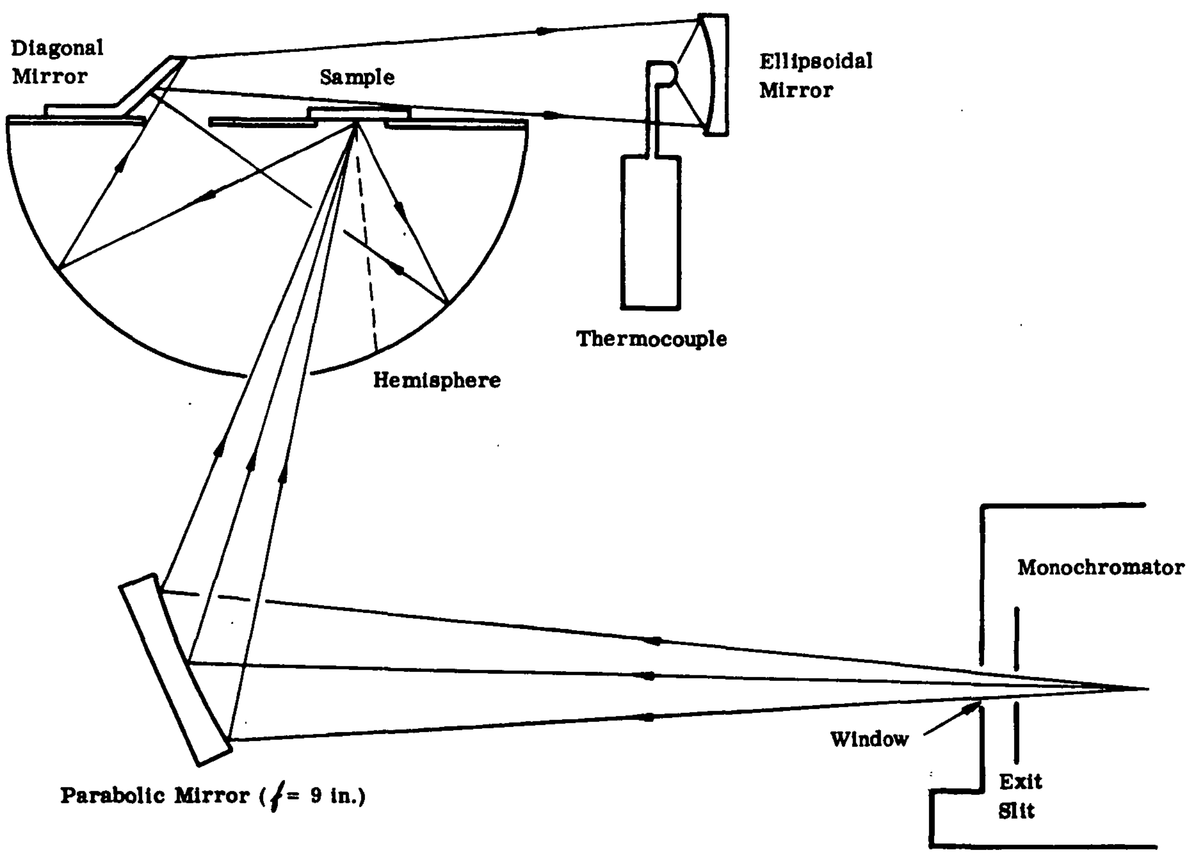


FIGURE 8. COBLENTZ HEMISPHERE USED BY DETROIT ARSENAL

443

and focused at a spot in the sample plane diametrically opposite the sample. By a system of mirrors the collected energy is focused on the detector.

The instrument was calibrated separately for specular reflectors and for diffuse reflectors. For specular reflectors, an evaporated aluminum standard of known reflectance was placed in the sample location, and the instrument slit widths were adjusted until the reading coincided with the predetermined value. The slit width was recorded for that wavelength and the procedure repeated at 1.0-μm intervals between 1 and 12 μm. The first wavelength read was 1 μm. The resulting set of slit widths was used for all samples considered specular, and the reading was recorded as reflectance. In the case of a diffuse reflector, the same procedure was followed using a smoked MgO standard.

I.2.8. NOTS POLARIZATION MEASUREMENTS [6]

The data obtained at the Naval Ordinance Test Station (NOTS), China Lake, Calif., consist of measurements of the degree of linear polarization of light reflected from target and background objects. The data result from a joint laboratory and field study and are reported in three forms:

(1) P_L vs. λ

(2) P_L vs. θ

(3) P_L vs. ϕ

where P_L = degree of linear polarization

λ = wavelength

θ = zenith angle of observation

ϕ = azimuth angle of observation

Field measurements were made using a specially designed polarimeter consisting of a Polaroid HN-22 high extinction linear polarization filter, an f/4 250-mm telephoto lens, an eyepiece to observe the field of view, and an RCA 200-4-25-2.0 silicon photodetector (Fig. 9). The wavelength was monitored by inserting any one of a series of 20-μm optical bandpass filters behind the polarization analyzer. The filters were centered at the following peak wavelengths: 486, 520, 546, 579, 589, 656, and 706 μm. The detector field of view was 2°.

The polarimeter was mounted on a tripod for measuring terrain. The positions of the sun and polarimeter with respect to the observed ground were recorded using the notation shown in Fig. 10. The polarization analyzer was then rotated and currents corresponding to the maximum and minimum transmitted fluxes (I_1 and I_2) were recorded. The degree of linear polarization was calculated from the following equation:

$$P_L = \frac{I_1 - I_2}{I_1 + I_2}$$

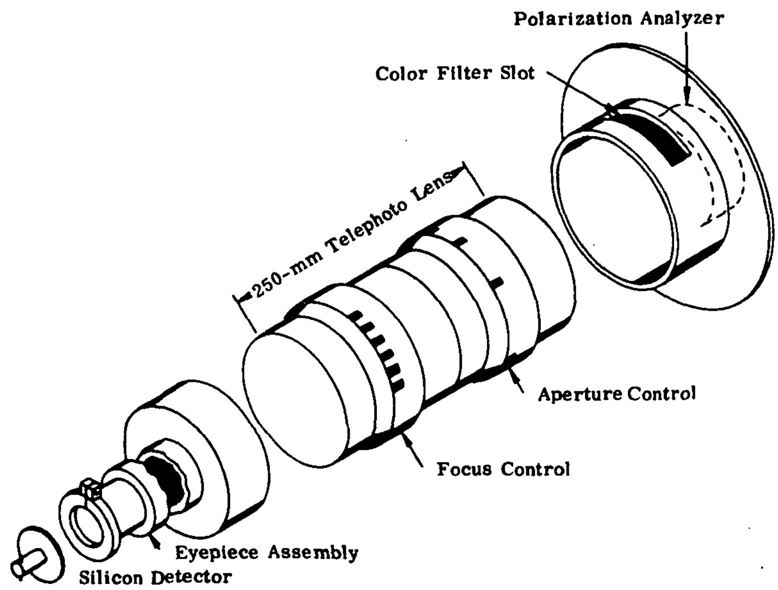


FIGURE 9. PHOTOELECTRIC FIELD POLARIMETER

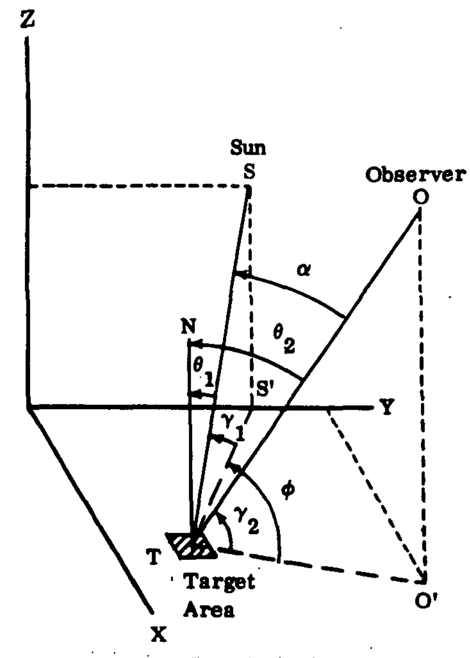


FIGURE 10. GEOMETRY OF FIELD MEASUREMENTS

Laboratory measurements were conducted in much the same way as the field studies. The instrument (Fig. 11) differed basically from the field instrument in two respects: (1) an artificial source was used rather than the natural illumination, and (2) the source and the detector were coplanar; for the field measurements, the detector could be situated at any desired azimuth in relation to the sun. The source was fixed, while the sample could be tilted to allow various incidence angles. The detector could also be moved independent of the sample holder to permit several viewing angles.

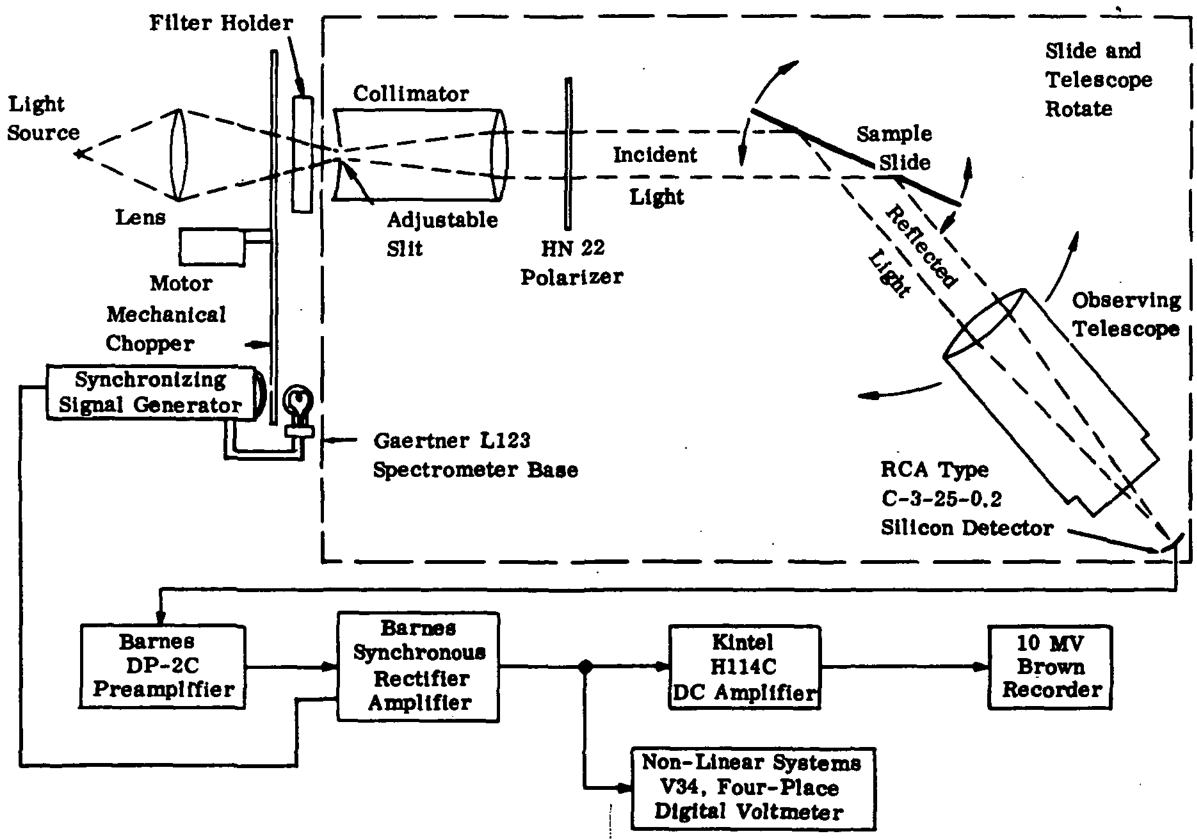


FIGURE 11. LABORATORY POLARIMETER AND INSTRUMENTATION

The illumination angles used in this study were 30°, 60°, and 80°, and the observation angle varied from 5° to 85°.

The polarizer was inserted in the incident beam in first the perpendicular and then the parallel orientation. Light reflected from the sample, $V_\perp$ and $V_{\parallel}$ respectively, was recorded.

Here the degree of linear polarization, P_L, is given by

$$P_L = \frac{V_\perp - CV_{\parallel}}{V_\perp + CV_{\parallel}}$$

where $V_{\perp i,r}$ = voltage observed upon reflection in the direction θ_r of perpendicularly polarized light at an incidence angle θ_i

$V_{\parallel i,r}$ = voltage observed upon reflection in the direction θ_r of parallel polarized light at an incidence angle θ_i

I.2.9. CARY 14R REFLECTOMETER

This instrument is shown schematically in Fig. 12. Sample illumination was achieved by placing a high intensity source at a small port in the bottom of the integrating sphere. The sample is thus illuminated by a broad spectral band, hemispherical source. A double prism grating monochromator then alternately looks at a $MgCO_3$ reference and the sample. This instrument may be operated over the 0.2- to 2.2-μm range.

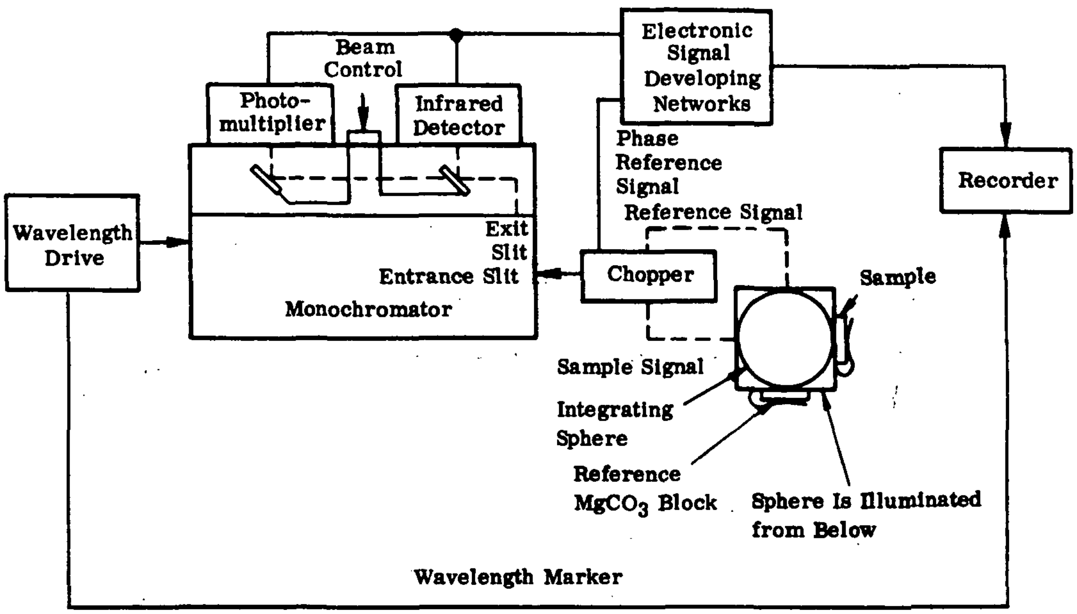


FIGURE 12. CARY 14R REFLECTOMETER [7]

I.2.10. PERKIN-ELMER NORMAL INCIDENCE REFLECTOMETER

This instrument is shown schematically in Fig. 13. In operation, broad spectral band light is collected and focused on the sample at the reflectance unit (Fig. 14). Light reflected from the sample is collected and focused onto the entrance slit of a Perkin-Elmer Model 99 monochromator where it is analyzed spectrally from 0.2 to 0.4 μm. The measurements were made using a $MgCO_3$ reflectance standard.

I.3. ABSOLUTE REFLECTANCE

As is apparent from the earlier discussion, the measurement of reflectance is usually made relative to an arbitrary standard, and it is presented in that manner in many cases in this com-

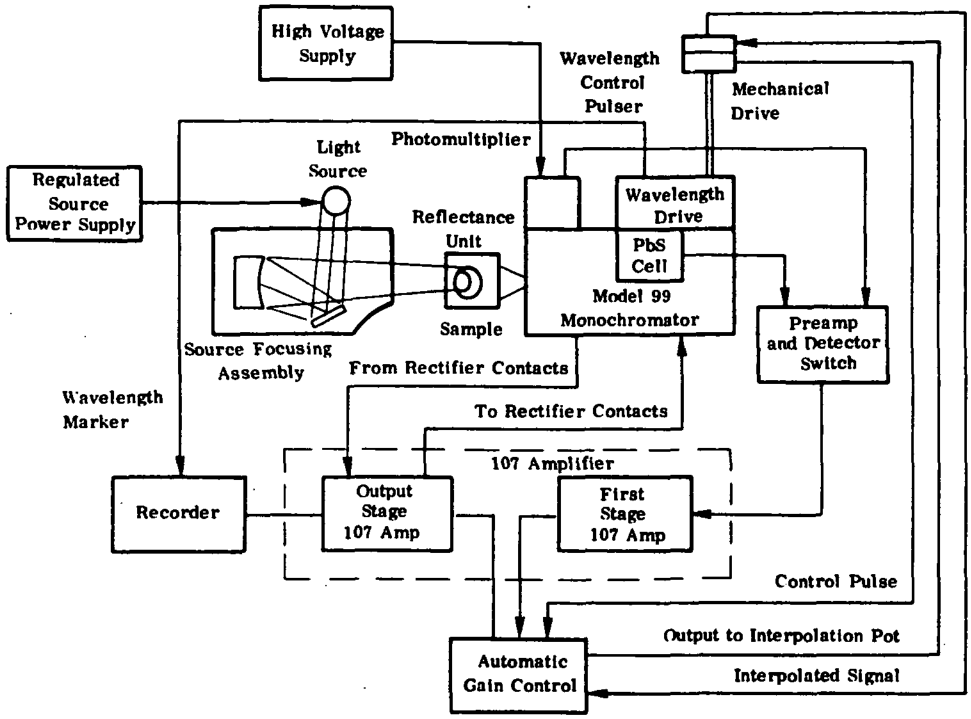


FIGURE 13. PERKIN-ELMER NORMAL INCIDENCE REFLECTOMETER [7]

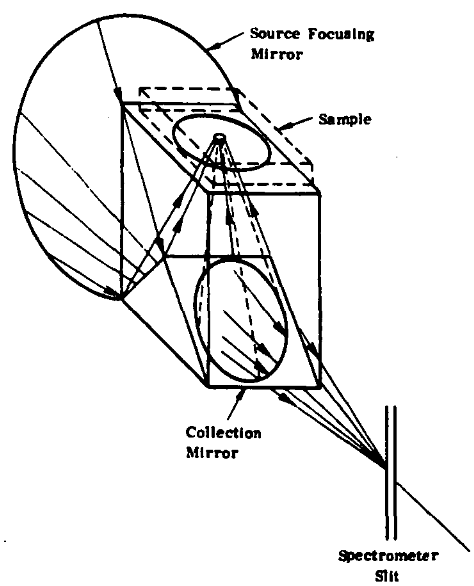


FIGURE 14. PERKIN-ELMER REFLECTANCE UNIT [7]

448

pilation. To convert such data to absolute values requires knowledge of the absolute reflectance of the standard used. An absolute measurement is of the following form:

$$\rho_d\left(\theta_i, \phi_i\right)_{abs} = \frac{p_{r,x}}{p_i} \tag{40}$$

where p_i is the power incident on the sample in the direction (θ_i, ϕ_i), and $p_{r,x}$ is the power reflected into a hemisphere by the sample. On the other hand, a relative measurement has the form

$$\rho_d\left(\theta_i, \phi_i\right)_{rel} = \frac{p_{r,x}}{p_{r,st}} \tag{41}$$

where, again, $p_{r,x}$ is the power reflected into a hemisphere by the sample, while $p_{r,st}$ is the power reflected into a hemisphere by some reflectance standard.

If the absolute directional reflectance of the standard, $\rho_{d,st}\left(\theta_i, \phi_i\right)_{abs}$ is known, the absolute reflectance of the sample can be calculated:

$$\rho_d\left(\theta_i, \phi_i\right)_{abs} = \frac{p_{r,st}}{p_i}$$

or

$$p_{r,st} = \rho_{d,st}\left(\theta_i, \phi_i\right)_{abs} p_i \tag{42}$$

Substituting Eq. (42) into Eq. (41) yields

$$\rho_d\left(\theta_i, \phi_i\right)_{rel} = \frac{p_{r,x}}{\rho_{d,st}\left(\theta_i, \phi_i\right)_{abs} p_i}$$

$$\rho_d\left(\theta_i, \phi_i\right)_{rel} = \frac{\rho_d\left(\theta_i, \phi_i\right)_{abs}}{\rho_{d,st}\left(\theta_i, \phi_i\right)_{abs}}$$

and, therefore,

$$\rho_d\left(\theta_i, \phi_i\right)_{abs} = \rho_d\left(\theta_i, \phi_i\right)_{rel} \rho_{d,st}\left(\theta_i, \phi_i\right)_{abs}$$

Thus, to obtain absolute values of the reflectance of a sample, it is necessary to multiply the relative reflectance of the sample by the absolute reflectance of the standard as measured at the same wavelength, incidence angle, etc.

To facilitate these computations, recommended values for the absolute reflectance of three commonly used reflectance standards, MgO, $BaSO_4$, and $MgCO_3$, are presented in Figs. 15 through 17. The reader is cautioned that although these curves are considered to represent the best data currently available, they are nevertheless subject to the errors inherent in the instrumentation used. If highly accurate results are necessary, the references cited should be consulted for a description of the measurement techniques and error analyses associated with the data. Section I.4 indicates which of the optical data are reported as absolute and which as relative. For the relative data, the reflectance standard has also been designated.

It should also be noted that even after corrections for the standard are applied to data in this compilation, the curves may or may not more truly represent absolute reflectance. This is because the reflectance of such standards may vary within a few percent on the basis of preparation techniques, thickness and age of the samples, their exposure to ultraviolet radiation, etc. Since very few of the experiments considered have indicated in their reports the absolute reflectance of the standard used or completely described its preparation, it is impossible to say that the absolute reflectance shown in Figs. 15 through 17 is identical to that of the standard used in a given experiment.

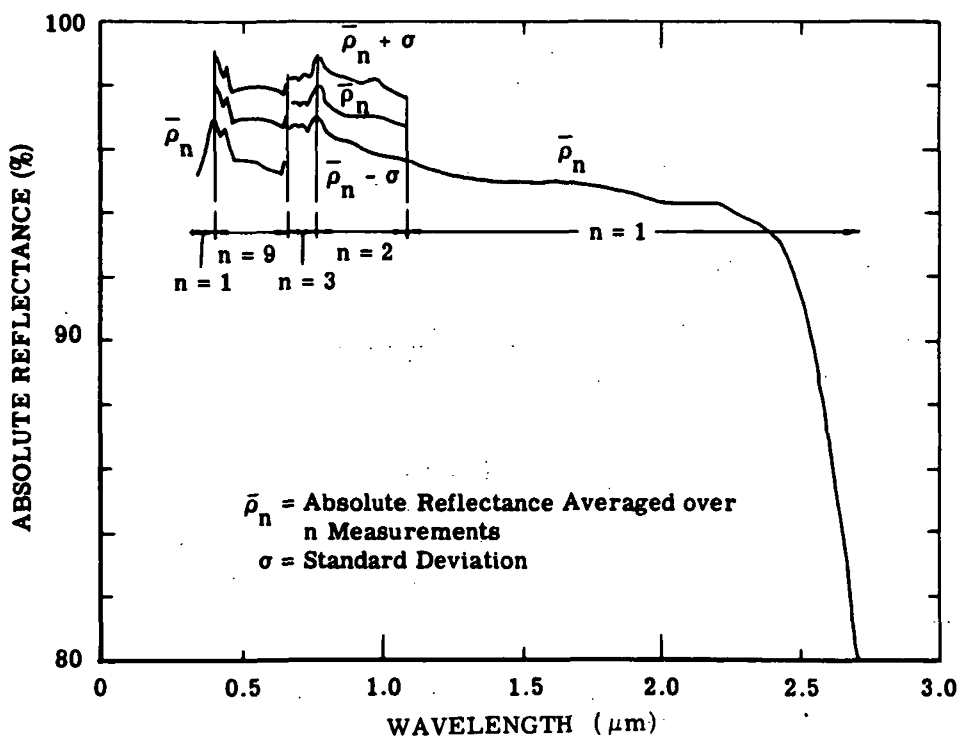


FIGURE 15. ABSOLUTE REFLECTANCE OF SMOKED MgO [8, 9, 10]

450

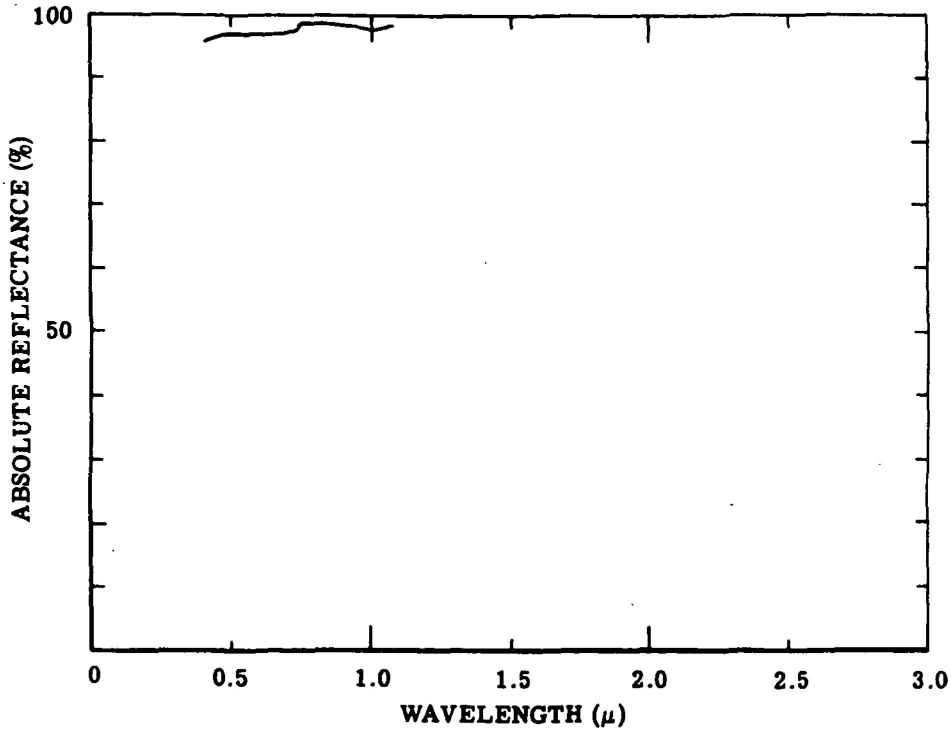


FIGURE 16. ABSOLUTE REFLECTANCE OF PRESSED $BaSO_4$ [9]

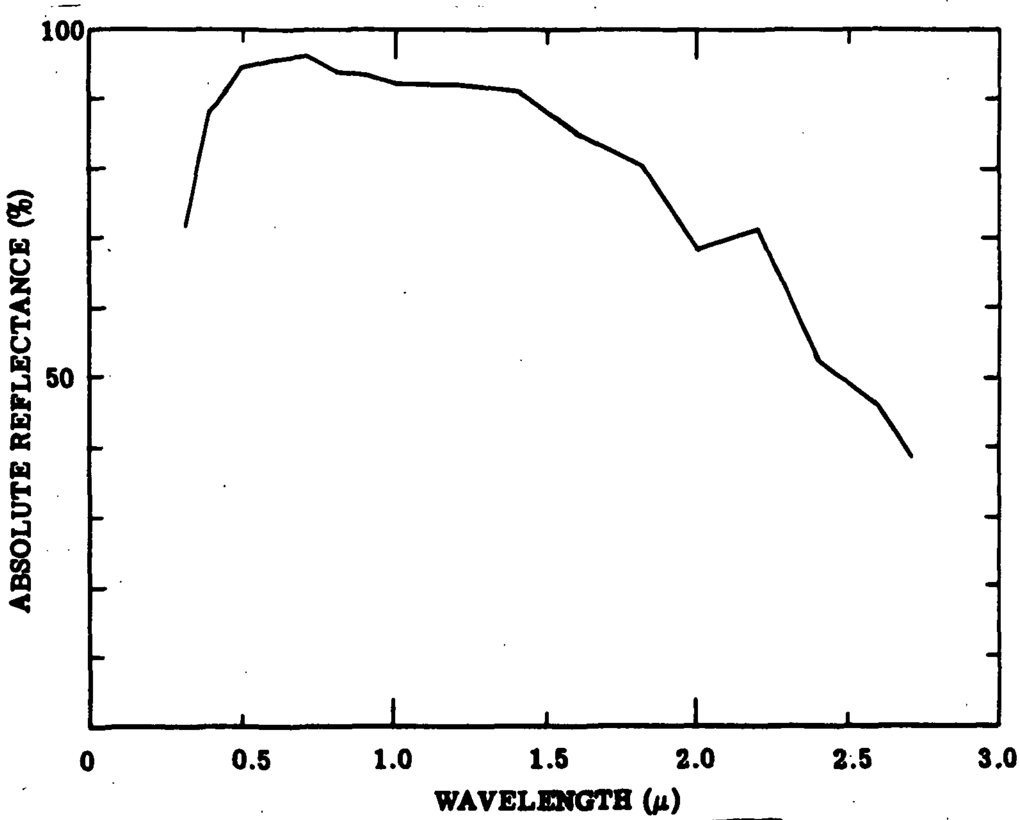


FIGURE 17. ABSOLUTE REFLECTANCE OF PRESSED $MgCO_3$ [8]

451

I.4. SUMMARY OF EXPERIMENTS YIELDING OPTICAL DATA

Each of the data curves published in this report has an identification number consisting of nine characters. The first of these is an alphabetic symbol, and the remaining eight are numeric. The alphabetic symbol is used to designate the original source of the data and to differentiate between measurements coordinated under various sponsored efforts.

The symbol A, used as a prefix to the identification number, implies that measurements have been made by The University of Michigan, Willow Run Laboratories under the Air Force Target Signatures Measurement Program.* The next five digits designate a specific sample which has been registered at The University of Michigan. For these, a complete sample description is maintained on file. The last three digits in the identification number are used to identify a particular area of the sample or a particular condition of measurement. Thus, for all measurements coordinated under the Target Signatures Measurements Program, the following hold true:

(1) All measurements of the same sample are linked together by identification number regardless of where the measurements were made.

(2) Parametric studies (such as moisture content and contamination on the same sample may be readily identified by the last three digits.

(3) Uniformity of descriptive information is obtained for data on the same samples.

The symbol B, used as a prefix to the identification number, is used to identify data taken from reports kept on file at The University of Michigan, Willow Run Laboratories or data which were obtained prior to the sample registration system. In these cases, the first five digits identify the document from which the data were taken.

The documents from which the optical data have been extracted are briefly summarized on the following pages. These summaries are included to facilitate use of the data presented in Section 4. Information on the experimental platform, instrumentation, reflectance standards (for relative data), and other related matters has been included, and additional references describing some of the instrumentation in greater detail are cited. Bibliographical information on each of the documents is stated; the user is referred to the original source if more detailed information is required.

B-00829. Hopkins: Reflectance Curves of Various Leaves, USAERDL, Ft. Belvoir, Virginia, ca. 1955 (unpublished).

Platform: laboratory

*The Air Force Target Signatures Measurements Program is sponsored by the Air Force Avionics Laboratory under Contract No. F33615-70-C-1698.

Instrument: USAERDL spectrophotometer (original design)
Quantity measured: ρ_d
Wavelength range: 0.9 to 2.7 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Comments: This instrument is no longer in operation. Basically, it consisted of a Gaertner monochromator coupled with an integrating sphere.

B-00830. Hopkins: Reflectance Curves of Various Soils, USAERDL, Ft. Belvoir, Virginia, ca. 1955 (unpublished).

Platform: laboratory

Instrument 1: Beckman DU spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.2 μm
Reflectance attachment: ellipsoidal mirror that collects radiation diffusely reflected from the sample
Reflectance standard: MgO
Additional Ref.: [11]

Instrument 2: USAERDL spectrophotometer (original design)
Quantity measured: ρ_d
Wavelength range: 0.9 to 2.7 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Comments: This instrument is no longer in operation. Basically, it consisted of a Gaertner monochromator coupled with an integrating sphere.

B-01035. Sigler: Airborne Rapid Scan Spectrometer and Earth Reflectance Measurements as a Function of Altitude (Final Report), Instrument Division, Radiation, Inc., Orlando, Florida, July 1957.

Platform: airborne

Instrument: Perkin-Elmer 108 rapid-scan spectrometer
Quantity measured: α(albedo)
Wavelength range: 0.4 to 3.0 μm
Reflectance standard: data are absolute
Comments: These data were obtained by rotating a periscope (installed through a hole in the side of the aircraft) 180° to alternately view the sky radiation and that reflected by the earth.

B-01049. Billings: Reflection of Visible and Infrared Radiation from Leaves of Different Ecological Groups, Am. J. Bot., Vol. 38, 1951.

Platform: laboratory

Instrument: Beckman DU spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.1 μm
Reflectance attachment: ellipsoidal mirror that collects radiation diffusely reflected from the sample
Reflectance standard: $MgCO_3$
Additional Ref.: [11]

B-01175. Derksen, Monahan: A Reflectometer for Measuring Diffuse Reflectance in the Visible and Infrared Regions, J. Opt. Soc. Am., Vol. 42, No. 4, 1952.

Platform: laboratory

Instrument 1: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.0 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

Instrument 2: Perkin-Elmer 12-B spectrometer
Quantity measured: ρ_d
Wavelength range: 1.0 to 2.7 μm
Reflectance attachment: Coblentz hemisphere
Reflectance standard: MgO
Additional Refs.: [14], [15]
Comments: See Section I.2.3.

B-01176. Wright: Spectral Reflectance Characteristics of Camouflage Greens Versus Camouflage Detection, IRMA III Report No. 1281, USAERDL, Ft. Belvoir, Virginia, March 1953.

Platform: laboratory

Instrument: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.08 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

B-01337. Dwornik, Orr, Young: Reflectance Curves of Soil, Rocks, Vegetation, and Pavement, Report No. 1746R, USAERDL, Ft. Belvoir, Virginia, April 1963.

Platform: ground-based field

Instrument: USAERDL portable spectrophotometer
Quantity measured: ρ'
Wavelength range: 0.25 to 2.5 μm
Reflectance attachment: collecting mirror
Reflectance standard: measured relative to thermoglass and values converted to MgO
Additional Ref.: [16]
Comments: See Section I.2.4.

B-01339. Haas, et al.: Spectrophotometric and Colorimetric Study of Color Transparencies of Some Natural Objects, Report No. 4794, NBS, Washington, D. C., March 1957.

Platform: laboratory

Instrument: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.08 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

B-01352. Haas, et al.: Spectrophotometric and Colorimetric Study of Diseased and Rust Resisting Cereal Crops, Report No. 4591, NBS, Washington, D. C., July 1956.

Platform: laboratory

Instrument: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.08 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

B-01353. Hall, Keegan, Schleter: Spectrophotmetric and Colorimetric Change in the Leaf of a White Oak Tree under Conditions of Natural Drying and Excessive Moisture, Report No. 4322, NBS, Washington, D. C., September 1955.

Platform: laboratory

Instrument: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.08 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

B-01367. Haas, et al.: Spectrophotometric and Colorimetric Study of Foliage Stored in Covered Metal Containers, Report No. 4370, NBS, Washington, D. C., November 1955.

Platform: laboratory

Instrument: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.08 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

B-01368. Haas, et al.: Spectrophotometric and Colorimetric Record of Some Leaves of Trees, Vegetation, and Soils, Report No. 4528, NBS, Washington, D. C., April 1956

Platform: laboratory

Instrument: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.08 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

B-01370. Duntley: Reflectance of Natural Terrains, Report No. OSRD 6554, Louis Comfort Tiffany Foundation, Oyster Bay, New York, September 1945.

Platform: airborne

Instrument: Eastman Kodak spectrogeograph
Quantity measured: α(albedo)
Wavelength range: 0.43 to 0.73 μm
Reflectance standard: data are absolute
Comments: The data were obtained by rotating a periscope (installed through a hole in the side of the aircraft) 180° to alternately view the sky radiation and that reflected by the earth. The spectrophotometric curves obtained were derived from densitometer readings of spectrograms.

B-01643. Reflectance Data on Crops, Mine Detection Branch, USAERDL, Ft. Belvoir, Virginia, ca. 1962 (unpublished).

Platform: ground-based field

Instrument: USAERDL portable spectrophotometer
Quantity measured: ρ'
Wavelength range: 0.25 to 2.5 μm
Reflectance attachment: collecting mirror
Reflectance standard: measured relative to thermoglass and values converted to MgO
Additional Ref.: [16]
Comments: See Section I.2.4.

B-01761. Shull: A Spectrophotometric Study of Reflection of Light from Leaf Surfaces, Botan. Gaz., Vol. 87, 1929.

Platform: laboratory

Instrument: spectrophotometer (original design)
Quantity measured: ρ_d
Wavelength range: 0.43 to 0.70 μm
Reflectance attachment: integrating sphere
Reflectance standard: $MgCO_3$

B-01818. Kronstein: Research, Studies, and Investigations on Spectral Reflectances and Absorption Characteristics of Camouflage Paint Materials and Natural Objects, Final Report, Contract DA-44-009 ENG-1447, New York University, New York, March 1955.

Platform: laboratory

Instrument 1: Beckman DK-2 spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 2.5 μm
Reflectance attachment: integrating sphere
Reflectance standard: data obtained relative to $MgCO_3$, but values converted to absolute
Comments: See Section I.2.2.

Instrument 2: Perkin-Elmer Model 12 and Model 112 spectrophotometers
Quantity measured: ρ_d
Wavelength range: 2.5 to 15 μm
Reflectance attachment: Coblentz hemisphere
Reflectance standard: Specular samples were measured relative to a rhodium mirror and diffuse samples relative to flowers of sulphur. Data have been converted to absolute values.
Comments: See Section I.2.3.

B-01948. Dinger: The Absorption of Radiant Energy in Plants, Ph.D Thesis, Iowa State University, Iowa City, 1941.

Platform: laboratory

Instrument: photometric goniometer (original design)
Quantity measured: ρ', τ' (bidirectional transmittance)
Wavelength range: 0.35 to 0.75 μm
Reflectance standard: bond paper
Comments: Reflectance data were obtained by focusing monochromatic light on the sample at normal incidence, then examining the reflected component at 10° off normal. Bond paper, believed by the experimenter to have scattering properties similar to those of foliage, was measured in the same way, and the ratio of the two quantities is the reported reflectance. Transmittance measurements relative to bond paper were also made.

B-02418. Spectral Reflectance of Several Crops, Purdue University, Lafayette, Indiana, 1964, (unpublished).

Platform: laboratory

Instrument: Beckman DK-2 spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.28 to 2.6 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Comments: See Section I.2.2.

B-03256. Clark, Hardy, Vinegar: Goniometric Spectrometer for the Measurement of Diffuse Reflectance and Transmittance of Skin in the Infrared Region, J. Opt. Soc. Am., Vol. 43, No. 11, 1953.

Platform: laboratory

Instrument: goniometer coupled with a Wadsworth-Littrow spectrometer
Quantity measured: ρ_d
Wavelength range: 0.55 to 2.5 μm
Reflectance attachment: see comments below
Reflectance standard: data are absolute
Comments: Measurement of diffuse reflectance was obtained by illuminating the sample with monochromatic light and automatically scanning the detector about the sample. The detector thus recorded the reflectance integrated over 180°. This process was repeated at several discrete wavelengths.

B-03258. Ashburn, Wilson: Spectral Diffuse Reflectance of Desert Surfaces, J. Opt. Soc. Am., Vol. 46, No. 8, 1956.

Platform: ground-based field and airborne

Instrument: albedometer (original design)
Quantity measured: α(albedo)
Wavelength range: 0.4 to 0.65 μm
Reflectance attachment: integrating sphere
Reflectance standard: unspecified, if any
Additional Ref.: [18]
Comments: No information on whether the data are absolute or relative was available.

B-03333. Infrared Optical Measurements, Report No. 8626, NBS, Washington, D. C., December 1964.

Platform: laboratory

Instrument 1: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range : 0.4 to 1.08 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

Instrument 2: Cary 14 spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.26 to 2.2 μm
Reflectance attachment: integrating sphere (Cary 1411)
Reflectance standard: MgO
Additional Ref.: [17]
Comments: Operation is similar to that of the integrating sphere discussed in Section I.2.2. However, in this experiment, the sample was illuminated with white light, and the radiation was spectrally dispersed after reflection. Also, the sample was viewed at 60° off normal.

Instrument 3: Cary 90 spectrophotometer
Quantity measured: ρ_d
Wavelength range: 2.5 to 14 μm
Reflectance attachment: white hemisphere
Reflectance standard: data are absolute
Additional Ref: [19]
Comments: The White attachment is basically a Coblentz-type hemisphere (see Sec. I.2.3). The sample was hemispherically illuminated with white light, and the reflected radiation was viewed slightly off normal.

B-03559. Barbrow: Calibration on the Spectral Directional Reflectance of Six Samples of Red Pine Needles, NBS, Test No. G-35201-1, Agricultural Research Center, Belleville, Maryland, November 1964, (unpublished).

Platform: laboratory

Instrument 1: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.08 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

Instrument 2: Cary 14 spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.26 to 2.2 μm
Reflectance attachment: integrating sphere (Cary 1411)
Reflectance standard: MgO
Additional ref.: [17]
Comments: Operation is similar to that of the integrating sphere discussed in Section I.2.2. However, in this experiment, the sample was illuminated with white light, and the radiation was spectrally dispersed after reflection. Also, the sample was viewed at 60° off normal.

Instrument 3: Cary 90 spectrophotometer
Quantity measured: ρ_d
Wavelength range: 2.5 to 15 μm
Reflectance attachment: White hemisphere
Reflectance standard: data are absolute
Additional Ref.: [19]
Comments: The White attachment is basically a Coblentz-type hemisphere (see Sec. I.2.3.) The sample was hemispherically illuminated with white light, and the reflected radiation was viewed slightly off normal.

B-03355. Miscellaneous data from several sources including New York University, Syracuse University and Detroit Arsenal, Warren, Mich., ca. 1950, (unpublished).

Platform: Laboratory

Instrument: see comments below
Quantity measured: ρ_d
Wavelength range: 0.4 to 15.0 μm
Reflectance attachment: see comments below
Reflectance standard: see comments below
Comments: Several unpublished, miscellaneous curves from various sources are collected here. Curves B-0335-001 through B-03355-006 are transmission data on optical materials, and no descriptive information on the instrumentation for them was available. Curves B-03355-007 through B-03355-009 are the reflectance of water from 1 to 15 μm, for angles of incidence of 0°, 60°, and 80°. Again, no descriptive information on this experiment was available. Curves B-03355-010 through B03355-037 are reflectance data on foliage species for the visible and near-infrared regions and appear to be standard spectrophotometric curves (ρ_d). Curves B-03355-039 through B-03355-046 are the reflectance (ρ_d) of paints in the 0.4- to 2.6-μm interval and are believed to have been obtained, relative to MgO, on the Beckman DK-2 spectrophotometer (see Sec. I.2.2.). Curves B-03355-047 through B-3355-053 were obtained on the Bausch and Lomb spectrophotometer (see under B04642).

B-03374. Olson, et al.: An Analysis of Measurements of Light Reflectance from Tree Foliage Made During 1960 and 1961, Report on Contract NR-387-025, Agricultural Experimental Station, University of Illinois, Urbana, Illinois, June 1964, AD 608-114.

Platform: laboratory

Instrument: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 0.7 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

B-03995. Krinov: Spectral Reflectance Properties of Natural Formations (translated by Belkov), Technical Translation No. 439, Natural Resources Council of Canada, Ottawa, 1953.

Platform: Ground-based field and airborne

Instrument: several spectrographs
Quantity measured: ρ'
Wavelength range: 0.4 to 0.9 μm
Reflectance attachment: none
Reflectance standard: barite paper, gypsum
Comments: See Section I.2.5.

459

B-04424. Hall: Measurement on the Optical Properties of Snow, Willow Run Laboratories of the Institute of Science and Technology, The University of Michigan, Ann Arbor, ca.1965, (unpublished).

Platform: laboratory

Instrument: interferometric device
Quantity measured: ρ'
Wavelength range: 0.95 to 2.7 μm
Reflectance standard: flowers of sulphur

B-04616. Myers, Thomas: Reflectance of Cotton Leaves Under Various Conditions of Drying, U. S. Dept. of Agr., Agricultural Research Center, Weslaco, Texas, June 1966, (unpublished).

Platform: laboratory

Instrument: Beckman DK-2 spectrophotometer
Quantity measured: ρ_d, τ_d
Wavelength range: 0.5 to 2.5 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO for ρ_d, but values of τ_d are absolute
Comments: For transmittance measurements, the sample was positioned at one of the entrance ports of the integrating sphere, and MgO was placed at both the sample and reference ports (cf. Fig. 3). Thus, energy transmitted into a hemisphere was seen by the detector. (See Section I.2.2.)

B-04802. Korbel: Thermal and Optical Characteristics of Eniwetok Sand (Final Report), Materials Laboratory, New York Naval Shipyard, Brooklyn, New York, November 1952.

Platform: laboratory

Instrument: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.08 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

B-04803. Cooper, Derksen: Spectral Reflectance and Transmittance of Forest Fuel Materials (Final Report), Material Lab, New York Naval Shipyard, Brooklyn, New York, March 1952.

Platform: laboratory

Instrument 1: General Electric spectrophotometer
Quantity measured: ρ_d, τ_d
Wavelength range: 0.4 to 1.0 μm
Reflectance attachment: integrating sphere
Reflectance standard: ρ_d data obtained relative to MgO, but values converted to absolute; value of τ_d are absolute
Additional Refs.: [3], [12], [13]
Comments: For transmittance measurements, the sample was placed at one of the entrance ports of the integrating sphere, and MgO covered both the sample and reference ports. Also see Section I.2.1.

Instrument 2: Perkin-Elmer infrared spectrometer
Quantity measured: ρ_d, τ_d
Wavelength range: 1.0 to 2.7 μm
Reflectance attachment: Coblentz hemisphere
Reflectance standard: ρ_d data obtained relative to MgO, but converted to absolute; values of τ_d are absolute
Additional Refs.: [14], [15]
Comments: See Section I.2.3.

B-04804. Hovis: Infrared Reflectivity of Some Common Minerals, Appl. Opt., Vol. 5, No. 2, 1966

Platform: laboratory

Instrument 1: Beckman DK-2 spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.5 to 2.5 μm
Reflectance attachment: integrating sphere
Reflectance standard: unspecified
Comments: See Section I.2.2.

Instrument 2: Cary 90 spectrophotometer
Quantity measured: ρ_d
Wavelength range: 2.5 to 6.0 μm
Reflectance attachment: White hemisphere
Reflectance standard: data are absolute
Additional Ref.: [19]
Comments: The White attachment is basically a Coblentz type hemisphere (see Sec. I.2.3.) The sample was hemispherically illuminated with white light, and the reflected radiation was viewed slightly off normal.

B-04979. Edwards, et al.: Basic Studies on the Use and Control of Solar Energy (Annual Report, Aug. 1959 to Aug. 1960), University of California, Los Angeles, October 1960.

Platform: laboratory

Instrument 1: Beckman DK-2 spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.25 to 2.5 μm
Reflectance attachment: integrating sphere
Reflectance standard: data obtained relative to MgO, but values converted to absolute
Comments: See Section I.2.2.

Instrument 2: General Electric spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.4 to 1.0 μm
Reflectance attachment: integrating sphere
Reflectance standard: data obtained relative to $MgCO_3$, but values converted to absolute
Additional Refs.: [3], [12], [13]
Comments: See Section I.2.1.

Instrument 3: Perkin-Elmer spectrophotometer
Quantity measured: ρ_d
Wavelength range: 1.25 to 15 μm
Reflectance attachment: Hohlraum
Reflectance standard: data are absolute
Comments: See Section I.2.6.

B-14004. Williamson: Night Reconnaissance Subsystem (U), (Final Technical Documentary Report), Martin-Marietta Corp., Orlando, Florida, November 1964, AD 355 324 (CONFIDENTIAL).

Platform: laboratory

Instrument 1: Cary Model 14R spectrophotometer
Quantity measured: ρ_d
Wavelength range: 0.2 to 2.2 μm
Reflectance attachment: integrating sphere
Reflectance standard: $MgCO_3$
Additional Ref.: [12]
Comments: See discussion in Section I.2.9

Instrument 2: Perkin-Elmer normal incidence spectrophotometer
Quantity measured: ρ'
Wavelength range: 0.2 to 0.42 μm
Reflectance attachment: Perkin-Elmer reflectance unit
Reflectance standard: $MgCO_3$
Comments: See discussion in Section I.2.10.

B-14438. Report on Measurement on the Paint of Russian and Danish Warships (U), Research on Camouflage Spectral Analysis (U), Danish Defence Research Board, Copenhagen, Denmark, ca. 1964, AD 370 905L (SECRET).

Platform: laboratory

Instrument: Beckman DU spectrophotometer
Quantity measured: reflectance; however, it was not specified whether directional or bidirectional
Wavelength range: 0.4 to 1.15 μm
Reflectance attachment: not specified
Reflectance standard: not specified, but probably MgO as was used in B-11356
Comments: Very little documentation of experimental procedure was given. These data, therefore, should only be used qualitatively.

B-19999. Trytten, Flowers: Reflectance of Target and Background Materials, Willow Run Laboratories of the Institute of Science and Technology, The University of Michigan, Ann Arbor, unpublished, (CONFIDENTIAL).

Platform: laboratory

Instrument: Beckman DK-2 spectrophotometer
Quantity measured: ρ_d, τ_d
Wavelength range: 0.28 to 2.6 μm
Reflectance attachment: integrating sphere
Reflectance standard: MgO for ρ_d, but values of τ_d are absolute
Comments: See discussion in Section I.2.2. For transmittance measurements, the sample was positioned at the entrance ports of the integrating sphere, and MgO was placed at both the sample and reference ports. Thus, energy transmitted into a hemisphere was seen by the detector.

B-02131. Lyon: Evaluation of Infrared Spectrophotometry for Compositional Analysis of Lunar and Planetary Soils: Rough and Powdered Surfaces, (Final NASA Report, Part II), Stanford Research Institute, Menlo Park, California, February 1964.

Platform: laboratory

Instrument: Perkin-Elmer Model 112 infrared spectrophotometer
Quantity measured: ρ'
Wavelength range: 7.8 to 13.0 μm
Emittance standard: Razor blade blackbody
Comments: Although the data are very well documented, the normalization process does not produce correct absolute emissivities for all samples. This data is excellent, however, for relative emissivity use.

B-07139. Martin Marietta: Application of Remote Sensor Data to Geologic and Economic Analysis of the Bonanza Test Site, Colorado; First Year Summary Report, Martin Marietta, Denver, Colorado, March 31, 1970.

Platform: laboratory

Instrument: Perkin-Elmer Model 98 monochromator with Gier Dunkle Parabolic Reflectometer
Quantity Measured: ρ_λ
Wavelength range: 7 to 14 μm
Reflectance standard: Not stated
Comments: The data looks quantitatively accurate, although no statement is made about the reflectance standard. Reflection measurements are plotted as 1 - ρ_λ. Sample is illuminated over 2π radians by parabolic reflector.
Source: Heated cavity source with 2.5-in. round aperture
Detector: High sensitivity radiation thermocouple

Appendix II
LIST OF RELATED REPORTS

The following reports describe additional remote sensing work performed by the Infrared and Optics Laboratory, Willow Run Laboratories, Institute of Science and Technology, The University of Michigan, Ann Arbor, Michigan.

THE INVESTIGATION OF A METHOD FOR REMOTE DETECTION OF LIFE ON A PLANET, L. D. Miller, Report No. 6590-4-F, Grant No. NsG 715, November 1965.

UNUSUAL RECONNAISSANCE CONCEPTS INTERIM REPORT, VOLUME II: SOURCES OF EXPERIMENTAL ERRORS IN SPECTROPHOTOMETRIC MEASUREMENTS, D. Goerge and T. Limperis, Report No. 5698-33-P(II), AFAL-TR-65-331, January 1966, AD 481 796, RC019423.

UNUSUAL RECONNAISSANCE CONCEPTS INTERIM REPORT, VOLUME III: A BIBLIOGRAPHY OF RECENT CONTRIBUTIONS ON ELECTROMAGNETIC AND ACOUSTIC SCATTERING, J. Ulrich, Report No. 5698-33-P(III), AFAL-TR-65-331, January 1966, AD 481 817.

TARGET SIGNATURE ANALYSIS CENTER: DATA COMPILATION, Report No. 7850-2-B, July 1966, AD 489 968

Second Supplement: Report No. 8492-5-B, July 1967, AD 819 712
Fifth Supplement: Report No. 8492-15-B, August 1968, AD 840 091
Addendum: Report No. 8492-26-B, October 1968
Seventh Supplement: Report No. 8492-35-B, January 1969, AD 856 343
Tenth Supplement: Report No. 8492-49-B, July 1969, AD 864 957

DISPERSIVE MULTISPECTRAL SCANNING: A FEASIBILITY STUDY, FINAL REPORT, J. Braithwaite, Report No. 7610-5-F, U.S.G.S. Department of Interior Contract No. 14-08-001-10053, September 1966.

AN INVESTIGATIVE STUDY OF A SPECTRUM-MATCHING IMAGING SYSTEM, FINAL REPORT, D. S. Lowe, J. Braithwaite and V. L. Larrowe, Report No. 8201-1-F, Contract NAS 8-21000, October 1966.

INFRARED AND PHOTO ANALYSIS, VOLUME I: A MATHEMATICAL PREDICTIVE MODEL FOR TARGET TEMPERATURE AS A FUNCTION OF ENVIRONMENT, D. D. Bornemeier and R. Horvath, Report No. 7417-14-F(I), Contract AF 30(602)-3840, November 1966.

INFRARED AND PHOTO ANALYSIS, VOLUME II: INTERPRETATION OF STRATEGIC IR IMAGERY, E. Kurath, and R. E. Hamilton, Report No. 7417-14-F(II), Contract AF 30(602)-3840, November 1966.

INFRARED AND PHOTO ANALYSIS, VOLUME III: INTERPRETATION OF TACTICAL INFRARED IMAGERY, G. E. Gnauck and R. E. Hamilton, Report No. 7417-14-F(III), Contract AF 30(602)-3840, November 1966.

OPTICAL SENSING OF MOISTURE CONTENT IN FINE FOREST FUELS, FINAL REPORT, C. E. Olson, Jr., Report No. 8036-1-F, USDAW-1209-FS-66, Contract 13-220, May 1967.

MULTISPECTRAL DISCRIMINATION OF SMALL TARGETS, F. Thomson, Report No. 6400-135-T, Contract DA 28-043-AMC-00013(E), December 1967, AD 389 761.

METALLIC REFLECTION, J. P. Ulrich, Report No. 8492-21-T, Contract F33615-67-C-1293, March 1968.

USE OF IMAGE-INTENSIFIERS FOR REAL-TIME MULTISPECTRAL VIEWING, C. Paprocki and R. Miller, Report No. 7919-26-T, July 1968.

CALIBRATION OF AN AIRBORNE MULTISPECTRAL OPTICAL SENSOR, L. M. Larsen and P. G. Hasell, Jr., Report No. 6400-137-T, Contract DA 28-043-AMC-00013(E), September 1968, AD 842 419.

THE REFLECTANCE OF SOME CLEAN AND CONTAMINATED MILITARY PAINTS, J. P. Ulrich, Report No. 8492-32-T, Contract F33615-67-C-1293, September 1968.

STATISTICAL SPECTRAL ANALYZER AND TARGET RECOGNITION COMPUTER (SPARC), FINAL REPORT, F. J. Kriegler and M. M. Spencer, Report No. 8640-17-F, Contract F33615-67-C-1384, September 1968, AD 392 774.

INVESTIGATIONS OF SPECTRUM-MATCHING TECHNIQUES FOR REMOTE SENSING IN AGRICULTURE, Report No. 1674-10-F, Contract No. 12-14-100-9503(20), December 1968.

EFFECTS OF ATMOSPHERIC PATH ON AIRBORNE MULTISPECTRAL SENSORS, R. Horvath, J. Braithwaite and F. Polcyn, Report No. 1674-5-T, NsG 715/23-05-071, January 1969.

REMOTE SENSING TECHNIQUES FOR THE LOCATION AND MEASUREMENT OF SHALLOW-WATER FEATURES, F. C. Polcyn and R. A. Rollin, Report No. 8973-10-P, January 1969, AD 848 054.

STUDY OF REQUIREMENTS TO CALIBRATE RECONOFAX IV and RS-7 INFRARED SCANNERS, D. S. Lowe and J. G. Braithwaite, Report No. 2122-8-X, February 1969.

DEVELOPMENT OF AN AERIAL BACKGROUND MEASUREMENT SYSTEM, P. G. Hasell, Report No. 2134-8-F, March 1969.

TARGET TEMPERATURE MODELING, D. Bornemeier, R. Bennet and R. Horvath, Report No. 1588-5-F, RADC TR 69-404, December 1969.

FURTHER INFRARED SYSTEMS STUDIES FOR THE EARTH RESOURCES PROGRAM, J. G. Braithwaite, L. Larsen and E. Work, Report No. 2122-14-F, December 1969.

APPLICATIONS OF MULTISPECTRAL REMOTE SENSING TECHNIQUES TO HYDRO-BIOLOGICAL INVESTIGATIONS IN EVERGLADES NATIONAL PARK, A. L. Higer, N. S. Thomson, F. J. Thomson and M. C. Koplinski, Report No. 2528-5-T, January 1970.

INVESTIGATION OF MULTISPECTRAL DISCRIMINATION TECHNIQUES, R. Nalepka, Report No. 2264-12-F, Contract 12-14-100-9548(20), January 1970.

MEASUREMENTS PROGRAM FOR OIL-SLICK CHARACTERISTICS, R. Horvath, W. Morgan and R. Spellicy, Report No. 2766-7-F, February 1970.

MULTISPECTRAL REMOTE SENSING OF URBAN FEATURES, J. E. Colwell, Report No. 2772-6-F, Contract U.S.G.S. 14-08-0001-11968, March 1970.

INVESTIGATIONS OF MULTISPECTRAL DISCRIMINATION OF THE EARTH SURFACE FEDTURES, F. Thomson, Report No. 2528-10-F, April 1970.

AUTOMATIC PROCESSING AND ANALYSIS OF SOILS AND SOIL CONDITIONS, T. Wagner, Report No. 2760-2-F, July 1970.

A STUDY OF WATERFOWL HABITAT IN NORTH DAKOTA USING REMOTE SENSING TECHNIQUES, W. G. Burge and W. L. Brown, Report No. 2771-7-F, July 1970.

A GONIOREFLECTOMETER FACILITY USING COHERENT AND INCOHERENT SOURCES, M. E. Bair, D. C. Carmer and S. R. Stewart, Report No. 1652-24-T, AFAL-TR-70-161, August 1970, AD 874 434.

ATMOSPHERIC EFFECTS ON INFRARED MULTISPECTRAL SENSING OF SEA-SURFACE TEMPERATURE FROM SPACE, A. Anding and R. Kauth, Report No. 2676-4-P, August 1970.

ANALYSIS OF POLARIZATION AND THERMAL PROPERTIES OF TARGETS AND BACKGROUNDS, Report No. 3221-11-P, Contract No. F33615-70-C-1123, August 1970.

REPORTS ON CONTRACT NAS 9-9784

OPTICAL TRANSFER TECHNIQUES FOR OPTICAL SCANNERS, J. Braithwaite, E. Work, Report No. 3165-21-T, in publication.

STUDIES OF SPECTRAL DISCRIMINATION, W. A. Malila, R. Turner, R. Crane, C. Omarzu, Report No. 31650-22-T, in publication.

DETECTOR UTILIZATION IN LINE SCANNERS, L. Larsen, Report No. 3165-29-T, in publication.

A PROTOTYPE HYBRID MULTISPECTRAL PROCESSOR WITH HIGH THROUGHPUT CAPABILITY, F. Kriegler, R. Marshall, Report No. 3165-23-T, in publication.

DATA PROCESSING DISPLAYS OF MULTISPECTRAL DATA, F. Kriegler, R. Marshall, Report No. 31650-28-T, in publication.

CALIBRATION OF MULTISPECTRAL SCANNERS, J. Braithwaite, Report No. 3165-27-L, in publication.

INVESTIGATIONS OF MULTISPECTRAL SENSING OF CROPS, R. Nalepka, et al., Report No. 31650-30-T, in publication.

INVESTIGATION OF SHALLOW WATER FEATURES, F. Polcyn, et al., Report No. 31650-31-T, in publication.

NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM PROCEDURES MANUAL, V. Leeman, et, al., Report No. 3165-32-T, in publication.

DATA GAPS IN THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM, R. Vincent, Report No. 31650-25-T, in publication.

REMOTE SENSING DATA ANALYSIS PROJECTS ASSOCIATED WITH THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM, R. Vincent, et al., Report No. 31650-26-T, in publication.

INVESTIGATIONS RELATED TO MULTISPECTRAL IMAGING SYSTEMS FOR REMOTE SENSING, J. Erickson, Report No. 31650-17-P, in publication.

466

C-9

REFERENCES

1. Target Signature Analysis Center: Data Compilation, 7850-2-B, Willow Run Laboratories of the Institute of Science and Technology, The University of Michigan, Ann Arbor, July 1966, AD 489 968.
2. F. Nicodemus, "Directional Reflectance and Emissivity of an Opaque Surface," Appl. Opt., Vol. 4, 1965, pp. 767-773.
3. A. C. Hardy, "A New Recording Spectrophotometer," J. Opt. Soc. Am., Vol. 25, 1935, pp. 305-311.
4. E. L. Krinov, Spectral Reflectance Properties of Natural Formations, trans. by G. Belkov, Natl. Res. Council, Canada, Technical Translation No. 439, Ottowa, Ontario, 1953.
5. D. K. Wilburn and O. Renius, The Spectral Reflectance of Ordnance Materials at Wavelengths of 1 to 12 Microns (U), Detroit Arsenal, Centerline, Mich., 8 February 1965, AD 087 246 (CONFIDENTIAL).
6. V. W. McIntire, Light Polarizing Properties of Terrestrial Backgrounds and Painted Surfaces (U), Naval Ordnance Test Station, China Lake, Calif., September 1964, AD 354 613 (CONFIDENTIAL).
7. A. E. Williamson, Night Reconnaissance Subsystem (U) (Final Technical Documentary Report), Martin-Marietta Corp., Orlando, Fla., November 1964, AD 355 324 (CONFIDENTIAL).
8. H. T. Betz et al., Determination of Emissivity and Reflectivity Data on Aircraft Structural Materials, Part II: Techniques for Measurement of Total Normal Emissivity, Normal Spectral Emissivity, Solar Absorptivity, and Presentation of Results, Armour Research Foundation, Chicago, October 1958, AD 202 493.
9. D. G. Goebel, B. P. Caldwell, and H. K. Hammond, III. " Use of an Auxiliary Sphere with a Spectroreflectometer to Obtain Absolute Reflectance," J. Opt. Soc. Am., Vol. 56, 1966, pp. 783-788.
10. W. E. K. Middleton and C. L. Sanders, "The Absolute Spectral Diffuse Reflectance of Magnesium Oxide," J. Opt. Soc. Am., Vol. 41, 1951, pp. 419-424.
11. H. H. Cary and A. O. Beckman, "A Quartz Photoelectric Spectrophotometer," J. Opt. Soc. Am., Vol. 31, 1941, pp. 682-689.
12. A. C. Hardy, "History of the Design of the Recording Spectrophotometer," J. Opt. Soc. Am., Vol. 28, 1938, pp. 360-371.
13. K. S. Gibson and H. J. Keegan, "Calibration and Operation of the General Electric Recording Spectrophotometer of the National Bureau of Standards," J. Opt. Soc. Am., Vol. 28, 1938, pp. 372-385.
14. R. B. Barnes, R. S. McDonald, and V. Z. Williams, "Small Prism Infra-Red Spectrometry," J. Appl. Phys., Vol. 16, 1945, pp. 77-86.
15. W. L. Derksen and T. I. Monahan, "A Reflectometer for Measuring Diffuse Reflectance in the Visible and Infrared Regions," J. Opt. Soc. Am., Vol. 42, 1962, pp. 263-265.
16. W. D. McClellan, J. P. Meiners, and D. G. Orr, "Spectral Reflectance Studies on Plants," Proc. Second Symposium on Remote Sensing of Environment, 15, 16, 17 October 1962, Report No. 4864-3-X, Willow Run Laboratories of the Institute of Science and Technology, The University of Michigan, Ann Arbor, February 1963, AD 299 841, pp. 403-413.

17. H. J. Keegan, J. C. Schleter, and D. B. Judd, "Glass Filters for Checking Performance of Spectrophotometer Integrator Systems of Color Measurement," J. Res. Natl. Bur. Std., A, Vol. 66, 1962, p. 203.

18. E. V. Ashburn et al., "Narrow Pass Band Albedometer," Rev. Sci. Instr., Vol. 27, 1956, pp. 90-91.

19. J. U. White, "New Method for Measuring Diffuse Reflectance in the Infrared," J. Opt. Soc. Am., Vol. 54, 1964, pp. 1332-1337.

468