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THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION

Second Supplement

by

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Infrared and Optics Division

ENVIRONMENTAL RESEARCH INSTITUTE OF MICHIGAN
FORMERLY WILLOW RUN LABORATORIES.
THE UNIVERSITY OF MICHIGAN

prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Lyndon B. Johnson Space Center
Contract NAS 9-9784

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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 Environmental Research Institute of Michigan, for the Lyndon B. Johnson Space 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 resource problems such as crop yield and disease, urban land studies and development, air and water pollution, and forest and rangeland management. The scope of our program includes: (1) extending understanding of basic processes affecting the content and cost of the information; (2) developing new applications, advanced remote sensing systems, better automatic data processing to extract information in a useful form; and (3) assisting in data collection, processing, and analysis, including laboratory and field material spectra and ground-truth verification.

The research described herein was performed under NASA Contract NAS 9-9784, Task B 2.10, and covers the period 1 November 1971 through 31 January 1973. Dr. Andrew Potter was Technical Monitor. The program is directed by R. R. Legault, Associate Director of the Institute, and J. D. Erickson, Principal Investigator. The work was done under the management of the Earth Observations Division, Lyndon B. Johnson Space Center. The Institute number for this report is 31650-156-T. Reports issued by the Infrared and Optics Division on related programs are listed in Appendix II.

ACKNOWLEDGMENTS

The author is grateful for the efforts of Dr. D. E. Olson, W. Pillars, B. Salmon, and F. Mauk in compiling these data and preparing this report.

ABSTRACT

This report briefly describes the NASA Earth Resources Spectral Information System (ERSIS) and the information contained therein. It is intended for use as a second supplement to the "NASA Earth Resources Spectral Information System: A Data Compilation," NASA CR-31650-24-T, May 1971. The first supplement, NASA CR-31650-69-T, was published in March 1972.

The current supplement, NASA CR-31650-156-T includes approximately 100 rock and mineral, and 375 vegetation directional reflectance spectral curves in the optical region from 0.2 to 22.0 μm. The data have been categorized by subject and each curve plotted on a single graph. Each graph is fully titled to indicate curve source and indexed by subject to facilitate user retrieval from ERSIS magnetic tape records.

CONTENTS

TABLES

THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION
Second Supplement

1
SUMMARY

This report summarizes the NASA Earth Resources Spectral Information System (ERSIS) and the information contained therein. It is intended as a further supplement to the "NASA Earth Resources Spectral Information System: A Data Compilation," NASA CR-31650-24-T, May 1971, and "The NASA Earth Resources Spectral Information System: A Data Compilation, First Supplement," NASA CR-31650-69-T, March 1972.

This supplement contains curves showing, for the optical region 0.2 to 22.0 μm, the directional reflectance properties of approximately 100 rocks and minerals and 375 tree leaves. The data are categorized by subject with each curve plotted on a single graph. Each graph is fully titled to indicate curve source and indexed by subject to facilitate retrieval. In addition, the documents from which the curves have been extracted are summarized to facilitate data use. 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 data included in this as well as the two previous publications are available in digital form as part of ERSIS. The present NASA/MSC computer facility has a set of magnetic tapes containing the optical spectral data as well as a series of computer programs for updating the magnetic tapes, for retrieving data from the tapes, and for analyzing the retrieved data.

2
INTRODUCTION

The Earth Resources Spectral Information System (ERSIS) established at NASA/MSC in 1970 and maintained by Willow Run Laboratories is intended to provide the spectral signatures of natural targets to scientists in the remote sensing community in a simple catalog form. The current ERSIS consists of a set of magnetic tapes containing optical spectral data and a series of computer programs for updating these magnetic tapes, for data retrieval from the tapes, and for analysis. Sources for the data are reports published by Laboratories making such measurements and unpublished data acquired directly from experimenters.

All of the data incorporated into ERSIS during its first year were published in graphical form in a 1971 technical report [1]. That report covers approximately 100 rock and mineral, 2600 vegetation, 1000 soil, and 60 water spectra. The first supplement was published the following year; it includes roughly 500 rock and mineral, 100 soil, and 30 vegetation spectra added to the ERSIS in 1971 [2]. The second supplement contains approximately 100 additional rock and mineral and 375 vegetation spectra.

Data gaps pointed out in one of our reports published two years ago [3] influenced the choice of data added in both supplements. The new curves provide more spectra of rocks and minerals as well as spectra of vegetation from a specific study — a water stress investigation conducted by C. E. Olson, Jr. and W. G. Rohde at The University of Michigan. Although the remote sensing community's need for new experimental laboratory data continues to grow, an apparent decline is noted in the number of spectral measurements reported in the open literature during the past year.

Each data curve is assigned alphabetic and or numeric descriptor codes to describe the object measured. Lists of these codes appear in Section 2. Data curves have been grouped according to the code descriptor that best describes the object measured. This prime descriptor, a page number, and the common names of the objects are shown in Table 5.

Section 4 presents the directional reflectance spectral curves. These plots are arranged according to subject code with the vegetation group first, followed by rocks and minerals. Included with each plot is a title listing of the material measured, plus the curve and document numbers identifying the curve source.

Appendix I of this report describes the curve identification numbering system and briefly describes the documents from which the data were obtained. For more data and additional information about reflectance theory and the standard instrumentation procedures used to collect the data, the reader is strongly advised to inspect the original volume [1] and the first supplement [2], of this publication. The general areas in which additional spectra are needed are described in Ref. [3]. Four examples of the types of analyses made possible by a collection of ERSIS spectra are given in Ref. [4]. The techniques and software used for processing, retrieval, and routine analysis of ERSIS data are described in Ref. [5].

Three 1972 ERSIS reports, companions to our First Supplement, should be useful to ERSIS users. One, entitled "NASA/MSC Earth Resources Spectral Information System Procedures Manual, Supplement," by V. Leeman [6], is the updated version of Ref. [5]. Second, is a technical report entitled "Rock-Type Discrimination from Ratio Images of the Pisgah Crater, California Test Site," by R. Vincent [7], which describes the application of a ratio method devised last year [4] for an arid, rocky terrain. Yet another technical report by R. Vincent, G. Suits, H. Horwitz, and J. Erickson, "Investigation of Theoretical Methods for the Optical Modeling of Agricultural Fields and Rough-Textural Rocks and Mineral Surfaces," [8] gives

the results of a study on the problem of linking laboratory spectra with radiation detected by an airborne scanner for agricultural applications.

Currently being published as a companion to this Second Supplement is the sequel to Ref. [9]. Entitled "New Theoretical Models and Ratio Imaging Techniques Associated with the NASA Earth Resources Spectral Information System," by R. Vincent, G. Suits, and B. Drake, it carries the agricultural and rock surface models to conclusion, establishes the best two thermal infrared channels for applying the thermal ratio imaging technique developed in Refs. [4] and [7], and describes a simple automatic decision-processing technique developed as an outgrowth of the ratio imaging methods.

3
LIST OF SUBJECT CODES

As more data are added to the ERSIS, more detailed breakdowns and codes will be required. The numbers shown in parentheses correspond to the total number of spectra in ERSIS for each category, not just those spectra added to ERSIS in this publication. Numbers adjacent to the major subject-code categories indicate the number of curves included which do not fit into any of the subcategories under that major subject code.

Those agency investigators and scientists interested in using the ERSIS may have useful suggestions for improving the classification schemes and subject codes, and these will be welcome.

3.1. SOIL AND WATER SUBJECT CODES

Table 1 contains a list of alphabetic soil and water subject codes unchanged from [1, 2]. The soils are classified according to texture and soil series, whereas the water spectra are arranged according to macroscopic formation and physical state.

3.2. VEGETATION SUBJECT CODES

The alphabetic vegetation subject codes, classified according to biological families, are listed in Table 2. In Table 3, the vegetation spectra are classified with alphanumeric codes for common nomenclature. 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 entire plant families. (For additional vegetation curves, see [1 and 2].)

TABLE 1. SOIL AND WATER SUBJECT CODES
(Classified according to texture and series)

BE	Terrain Uniformity (213)
BEA	Flat (21)
BEB	Rolling
BEC	Hilly (4)
BED	Mountainous (38)
BEE	Rural (112)
BEF	Urban
BF	Soil (90)
BFA	Cultivated (27)
BFB	Uncultivated
BFC	Coarse Textured
BFCA	Sand (122)
BFCB	Loamy Sand (6)
BFD	Moderately Coarse Textured (1)
BFDA	Sandy Loam (30)
BFDB	Fine Sandy Loam (20)
BFE	Medium Textured
BFEA	Loam (28)
BFEB	Silt Loam (25)
BFEC	Silt (3)
BFF	Moderately Fine Textured
BFFA	Clay Loam (22)
BFFB	Sandy Clay Loam
BFFC	Silty Clay Loam
BFB	Fine Textured
BFGA	Sandy Clay
BFGB	Silty Clay
BFGC	Clay (42)
BFH	Other Constituents (13)
BFHA	Organic Material (3)
BFHB	Gravel (less than 3-in. diameter) (7)
BFHC	Cobbles (3- to 10-in. diameter) (6)
BFHD	Stones (greater than 10-in. diameter) (10)
BFHF	Salt (1)
BFI	Series
BFIA	Aguan (2)
BFIB	Aiken (2)
BFIC	Akron (2)
BFID	Alamance (2)
BFIE	Albion (2)
BFIF	Alonso (2)
BFIG	Barnes (3)
BFIH	Blakely (4)
BFII	Clareville (2)
BFIJ	Clarion (2)
BFIK	Collington (1)
BFIL	Colts Neck (9)
BFIM	Decatur (2)
BFIN	Dublin (3)
BFIO	Gooch (3)
BFIP	Grady (3)
BFIQ	Greenville (4)
BFIR	Gauthrie (2)
BFIS	Hainamanu (1)
BFIT	Hall (2)
BFIU	Hamakua (2)
BFIV	Herradura (2)
BFIW	Joplin (2)
BFIX	Marias (2)
BFIY	Marshall (2)
BFIZ	Matanzas (2)
BFJ	Series (Continued)
BFJA	Maury (3)
BFJB	Moaula (4)
BFJC	Naalehu (4)
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
BFJN	Rubicon (2)
BFJO	Ruston (8)
BFJP	Santa Barbara (4)
BFJQ	Texas Dune (2)
BFJR	Tifton (2)
BFJS	Tillman (2)
BFJT	Tilsit (2)
BFJU	Vernon (2)
BFJV	Weld (4)
BFJW	Windthorst (4)
BFJX	Yolo
BFJY	Zanesville (2)
BFK	Minerals (22)
BFL	Chemicals (14)
BH	Water (2)
BHA	Formations (2)
BHAA	Lake (6)
BHAB	Puddle
BHAC	River (4)
BHAD	Sea (12)
BHB	State
BHBA	Ice
BHBB	Ice and Liquid
BHBC	Liquid (8)
BHBD	Snow (29)

TABLE 2. VEGETATION SUBJECT CODES
(Classified according to families in a biological sense, e.g., Mustard Family)

BG	Vegetation (31)
BGA	Herbaceous, Algae Fungi
BGAA	Cladoniaceae Family (1)
BGAAA	Reindeer Moss (3)
BGB	Moss-Liverwort (6)
BGBA	Sphagnum Family
BGBAA	Sphagnum Moss (1)
BGC	Vascular (5)
BGCA	Banana Family (3)
BGCAA	Banana
BGCB	Bromeliaceae Family
BGCBA	Bunch Grass (1)
BGCC	Buckwheat Family
BGCCA	Buckwheat (1)
BGCD	Composite Family (2) (cf. Ligneous)
BGCDA	Daisy (3)
BGCDB	Goldenrod (1)
BGCDC	Ragweed (3)
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) (1)
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 (136)
BGCMA	Barley (15)
BGCMB	Bermuda Grass (1)
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 (140)
BGCN	Heath Family (5) (see also Ligneous)
BGCNA	European Blueberry
BGCNB	Heather (1)
BGCO	Mallow Family
BGCOA	Cotton (121)
BGCP	Mustard Family
BGCPA	Cabbage (5)
BGCPB	Mustard (1)
BGCQ	Nightshade Family
BGCQA	Potatoes (5)
BGCQB	Tomatoes (4)
BGCR	Pea (or Pulse) Family (3) (see also Lig-
BGCRA	Alfalfa (
BGCRB	Clover (8
BGCRC	Coffee plant (1)
BGCRD	Lentil (2)
BGCRE	Lima Bean (3)
BGCRF	Pea (1)
BGCRG	Peanut (9)
BGCRH	Soybean (158)
BGCRI	String Bean (4)
BGCS	Plantain Family
BGCSA	Plantain (?)
BGCT	Sedge Family (1)
BGCTA	Cotton Grass (1)
BGCTB	Sedge (5)
BGD	Ligneous (24)
BGDA	Arecaceae Family (7)
BGDAA	Areca Palm (3)
BGDB	Beech Family
BGDBA	Beech (24)
BGDBB	Chestnut (2)
BGDBC	Oak (160)
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	Sumach (2)
BGDG	Composite Family (2) (cf. Herbaceous)
BGDGA	Sagebrush (3)
BGDGB	Wormwood (3)

TABLE 2. VEGETATION SUBJECT CODES
(Classified according to families in a biological sense, e.g., Mustard Family) (Continued)

BGDH	Dogwood Family
BGDHA	Dogwood (35)
BGDI	Ebony Family
BGDIA	Ironwood (2) (cf. Hazel Family)
BGDIB	Persimmon (2)
BGDJ	Elm Family
BGDJA	Elm (23)
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	Sassafras (3)
BGDQ	Lily Family (2)
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 (4)
BGDTB	Tulip (2)
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 (6)
BGDXA	Cedar (8)
BGDXB	Fir (11)
BGDXC	Juniper (6)
BGDXD	Larch (4)
BGDXE	Pine (211)
BGDFX	Spruce (11)
BGDY	Plane-Tree Family
BGDYA	Sycamore (150)
BGDZ	Pea Family (5) (cf. Herbaceous)
BGDZA	Locust (4)
BGE	Ligneous (continued)
BGEA	Rose Family (16)
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 (1)
BGED	Vine Family
BGEDA	Virginia Creeper (3)
BGEE	Walnut Family (1)
BGEEA	Hickory (5)
BGEF	Willow Family (100)
BGEFA	Aspen (36)
BGEFB	Poplar (113)
BGEFC	Willow (6) (cf. Evening Primrose Family)
BGEFCA	Dwarf (2)
BGEFCB	Ground (1)
BGEG	Witch Hazel Family
BGEGA	Sweet Gum (52)
BGF	Leaf (138)
BGFA	Narrow (402)
BGFB	Broad (197)
BGFBA	Coriaceous (Leathery)
BGFBB	Membraneous
BGFBC	Lower Leaf Surface (478)
BGFBD	Upper Leaf Surface (564)
BGFC	Young (Spring) (89)
BGFD	Mature (Summer) (56)
BGFE	Old (Fall) (114)
BGFF	Dry (157)
BGG	Bark (38)
BGH	Twig (21)

TABLE 3. SUPPLEMENT TO VEGETATION SUBJECT CODES
(Classified according to families in a layman, user-oriented sense, e.g., Crops)

- 40 Herbs (1)
  - 41 Crops (2)
    - 41A Vegetables (47)
      - 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 (17)
      - 41B1 Barley (9)
        - 41B1A Barley field, stubble (6)
      - 41B2 Corn (23)
        - 41B2A Corn leaf, green (47)
        - 41B2B Corn leaf, brown (45)
        - 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 (7)
        - 41B3A Oats field, stubble (9)
      - 41B4 Sorghum leaf, green (22)
        - 41B4A Sorghum, brown (15)
      - 41B5 Wheat (25)
        - 41B5A Wheat field, normal stand (41)
        - 41B5B Wheat field, thin stand (35)
        - 41B5C Wheat, diseased (13)
        - 41B5D Wheat heads (6)
        - 41B5E Wheat, seedling stage (20)
    - 41C Clothing fibers (5)
      - 41C1 Cotton (121)
  - 42 Nonflowering plants and weeds (60)
    - 42A Grass (50)
      - 42A1 Diseased grass (10)
      - 42A2 Brown grass (59)
    - 42B Ilyas (13)
  - 43 Flowering plants (36)
    - 43A Alfalfa (32)
  - 44 Flowering weeds (22)
    - 44A Clover (8)
- 50 Shrubs (44)
  - 51 Dogwood (35)
- 60 Trees (7)
  - 61 Deciduous (49)
    - 61A Nut trees (4)
      - 61A1 Hickory leaf (5)
      - 61A2 Hazelnut leaf (6)
      - 61A3 Nutree bark (2)
      - 61A4 Chestnut leaf (2)
    - 61B Fruit trees (58)
      - 61B1 Plum fruit (3)
        - 61B1A Plum leaf (7)
        - 61B1B Plum, bark and twig (5)
    - 61C Ash (58)
    - 61D Aspen (37)
    - 61E Basswood (54)
    - 61F Beech (24)
    - 61G Birch (23)
    - 61H Catalpa (12)
    - 61I Elm (23)
    - 61J Maple (45)
      - 61J1 Silver maple (102)
      - 61J2 Red maple (21)
    - 61K Oak (45)
      - 61K1 White Oak (47)
      - 61K2 Black Oak (35)
      - 61K3 Burr Oak (32)
      - 61K4 Red Oak (374)
    - 61L Poplar (13)
      - 61L1 Cottonwood (97)
    - 61M Sweet gum (52)
    - 61N Sycamore (154)
    - 61O Tulip tree (or Yellow Tulip poplar) (112)
    - 61P Willows (8)
  - 62 Coniferous (37)
    - 62A Pine (19)
      - 62A1 Red (or Norway) pine (118)
      - 62A2 Scotch pine (68)
    - 62B Spruce (10)
      - 62B1 Spruce bark (1)

3.3. ROCK AND MINERAL SUBJECT CODES

The rock and mineral curves added to the ERSIS this year resulted in a slight expansion of the rock and mineral subject codes in this supplement. (For additional rock and mineral curves, see [1 and 2].) The new rock and mineral subject codes are given in Table 4. The codes are as detailed as is possible from the identifications reported and this variance in amount of detail results in some unevenness in the classification scheme. The silicate rocks are arranged approximately according to SiO_2 content.

4
SUBJECT INDEX

The common names of materials listed below provide an index to the new data plots found in Section 4. The index in Table 5 contains two main categories of materials: vegetation, and rocks and minerals. A search for data on dacite, for example, yields in the Rocks and Minerals section the following data:

Dacite . . . . . 101:1, 2, 5, 6, 8. The divider for subject code 101 in the published data on Rocks and Minerals yields the page numbers on which information concerning dacite is contained.

5
DATA PLOTS

This section contains a summary of the information added to ERSIS in 1972. The data are categorized by subject and organized with Vegetation first, followed by Rocks and Minerals. Within each of these sections, the data have been grouped by either their general or specific subject-descriptor code.

All but two of the curves appear as single plots. Included with each plot and identifying the curve source, is a title listing of the material measured plus the curve and document numbers.

The following definitions are included to facilitate use of the data:

(1) Bidirectional Reflectance. The source is collimated about a small solid angle, and the receiver aperture is small; the angles of incidence and observation are approximately discrete.

TABLE 4. ROCK AND MINERAL SUBJECT CODES
(Classified according to basic, acidic content)

100 Igneous Rocks
- 101 Acidic (Generally greater than 65% SiO_2) Silicate Rocks (1)
  - 101B Obsidian (5)
  - 101C Pumice (8)
  - 101D Tuff (9)
  - 101E Tektite (same as 142) (1)
  - 101F Quartz Monzonite (6)
  - 101G Dacite (15)
  - 101H Granite (6)
    - 101H1 Graphic Granite (1)
    - 101H2 Granite Gneiss (2)
    - 101H3 Potash Granite (1)
  - 101J Aplite (1)
    - 101J1 Granite Aplite (1)
    - 101J2 Pyroxene Aplite (1)
  - 101L Rhyolite (26)
  - 101N Trachyte (2)
  - 101Q Migmatite (2)
  - 101R Adamellite (8)
  - 101T Felsite (3)
  - 101U Pegmatite (4)
  - 101V Monzonite (5)
- 102 Intermediate (Generally 53% to 65% SiO_2) Silicate Rocks
  - 102A Syenite (4)
    - 102A1 Quartz Syenite (1)
    - 102A2 Nepheline Syenite (2)
  - 102B Andesite (22)
    - 102B1 Hypersthene Andesite (2)
    - 102B2 Hypersthene Andesite Vitrophyre
    - 102B3 Biotite Andesite Flow (2)
  - 102D Basalt (Intermediate) (1)
  - 102G Diorite (13)
    - 102G1 Augitediorite (1)
  - 102I Latite (30)
  - 102P Grandiorite (4)
- 103 Basic and Ultrabasic (Generally less than 53% SiO_2) Silicate Rocks (2)
  - 103A Gabbro (6)
    - 103A1 Garnet Gabbro (1)
    - 103A2 Augite Gabbro (1)
    - 103A3 Olivine Gabbro (1)
    - 103A4 Hornblende Gabbro (2)
  - 103B Basalt (Basic and Ultrabasic (52)
    - 103B1 Plagioclase Basalt (1)
  - 103C Pyroxenite (1)
  - 103D Diabase (3)
  - 103E Monchiquite (1)
  - 103F Peridotite (5)
  - 103L Serpentine (1)
  - 103M Limburgite (1)
  - 103N Dunite (8)
  - 103P Lava (5)
  - 103Q Anorthosite (1)

110 Sedimentary and Metamorphic Rocks (2)
- 111 Silicate Sedimentary and Metamorphic Rocks (2)
  - 111A Sandstone (1)
    - 111A1 Yellow Sandstone (2)
    - 111A2 Red Sandstone (2)
    - 111A3 Grey Sandstone (1)
  - 111B Schist (1)
  - 111F Shale (2)
  - 111H Siltstone (4)
  - 111J Chert (3)
  - 111K Quartzite (2)
- 112 Carbonate Sedimentary and Metamorphic Rocks (2)
  - 112A Limestone (13)
  - 112B Coral (2)
  - 112C Dolomite (same as 123A1) (1)
  - 112D Marble (1)

120 Minerals
- 121 Silicate Minerals (Associated primarily with Acidic Rocks)
  - 121A Quartz (44)
  - 121B K-Feldspar (Orthoclase) (9)
  - 121C Grey Feldspar (Plagioclase) (21)
  - 121D Light-Colored Micas (3)
  - 121E Clay minerals (Product of Weathering) (14)
- 122 Ferromagnesian Minerals (Associated primarily with Basic Rocks)
  - 122A Biotite and Phlogopite (3)
  - 122B Olivines (13)
  - 122C Pyroxenes (19)
  - 122D Amphiboles (28)
  - 122E Chlorites (Product of Weathering) (7)
  - 122F Serpentine (Alteration Product) (4)
  - 122G Talc (Alteration Product) (4)
- 123 Accessary Minerals (7)
  - 123A Carbonate Minerals (4)
    - 123A1 Calcium-Magnesium Carbonate (Dolomite) (Same as 112C (9)
    - 123A2 Magnesium Carbonate (Magnesite) (8)
    - 123A3 Calcium Carbonate (Calcite Limestone) (10)
    - 123A4 Sodium Carbonate (2)
    - 123A5 Copper Carbonate (Azurite, Malachite) (8)

TABLE 4. ROCK AND MINERAL SUBJECT CODES
(Classified according to basic, acidic content)
(Continued)

- 123A6 Manganese Carbonate (Rhodochrosite) (3)
- 123A7 Iron Carbonate (Siderite) (4)
- 123A8 Zinc Carbonate (Smithsonite) (2)
- 123A9 Strontium Carbonate (Strontianite) (2)
- 123A10 Barium Carbonate (Witherite) (3)

123B Sulphur, Sulfate and Sulfide Minerals (1)
- 123B1 Sulphur (4)
- 123B2 Calcium Sulfates and Sulfides (Gypsum, Anhydrite Sand) (25)
- 123B3 Aluminum Sulfates and Sulfides (Alunite) (4)
- 123B4 Barium Sulfates and Sulfides (Barite) (4)
- 123B5 Strontium Sulfates and Sulfides (Celestite) (4)
- 123B6 Sodium Sulfates and Sulfides (Thenardite) (4)
- 123B7 Iron Sulfates and Sulfides (Pyrite, Pyrrhotite, Jarosite, Arsenopyrite, Chalcopyrite, Jamesonite, Marcasite) (26)
- 123B8 Arsenic Sulfates and Sulfides (Realgar, Arsenopyrite, Enargite, Niccolite, Proustite, Cobaltite) (21)
- 123B9 Potassium Sulfates and Sulfides (Alunite, Jarosite) (5)
- 123B10 Copper Sulfates and Sulfides (Chalcocite, Chalcopyrite, Enargite) (13)
- 123B11 Mercury Sulfates and Sulfides (Cinnabar) (3)
- 123B12 Cobalt Sulfates and Sulfides (Cobaltite) (4)
- 123B13 Lead Sulfates and Sulfides (Galena, Jamesonite) (7)
- 123B14 Antimony Sulfates and Sulfides (Stibnite, Jamesonite, Pyrargyrite) (11)
- 123B15 Molybdenum Sulfates and Sulfides (Molybdenite) (3)
- 123B16 Nickel Sulfates and Sulfides (Niccolite) (3)
- 123B17 Silver Sulfates and Sulfides (Proustite, Pyrargyrite) (6)
- 123B18 Zinc Sulfates and Sulfides (Sphalerite) (2)

123C Nitrate and Nitrite Minerals
- 123C1 Sodium Nitrates and Nitrites (2)
- 123C2 Potassium Nitrates and Nitrites (2)

123D Phosphate Minerals

123E Carbonaceous Minerals
- 123E1 Silicon Carbide (4)
- 123E2 Graphite (1)
- 123E3 Peat and Coal (1)

123F Oxides and Hydroxides
- 123F1 Iron Ox. and Hydrox. (Limonite, Hematite, Goethite, Magnetite, Ilmenite) (25)
- 123F2 Manganese Ox. and Hydrox. (Psilomelane, Pyrolusite) (10)
- 123F3 Titanium Ox. and Hydrox. (Rutile, Ilmenite) (9)
- 123F4 Zinc Ox. and Hydrox. (Zincite) (4)
- 123F5 Aluminum Ox. and Hydrox. (Corrundum and Artificial Ruby, Diaspore, Gibbsite, Chrysoberyl) (18)
- 123F6 Beryllium Ox. and Hydrox. (Chrysoberyl) (4)
- 123F7 Copper Ox. and Hydrox. (Cuprite) (3)
- 123F8 Tin Ox. and Hydrox. (Cassiterite) (4)
- 123F9 Magnesium Ox. and Hydrox. (Brucite) (4)

123G Halides

124 Minor Silicate Minerals (23)

130 Ores and Hydrothermally Altered Rock

131 Ores (2)
- 131A Uranium Ore (1)

132 Hydrothermally Altered Rock (5)
- 132A Latite (Hydrothermally Altered) (2)

140 Meteorites

141 Chondrites
- 141A Leedy (2)
- 141B Farmington (2)

142 Tektites (Same as 101E) (1)

TABLE 5. INDEX TO NEW MATERIALS FOR SECOND SUPPLEMENT

Vegetation	
Red Oak leaves	61K:1-94
Rocks and Minerals	
Rocks	
Andesite	102:3
Anorthosite	103:10
Basalt	103:1-10
Dacite	101:1, 2, 5, 6, 8
Diabase	103:10
Diorite	102:1, 3
Gabbro	103:10
Granite	101:7, 9
Granodiorite	102:2
Monzonite	101:4, 8
Nepheline Syenite	102:2
Quartz Monzonite	101:5
Rhyolite	101:3, 7
Syenite	102:1, 2
Trachyte	101:8
Tuff	101:3

(2) Directional Reflectance. Either the source or the receiver is collimated about a small solid angle, and the other the hemisphere. For example, a parabolic reflectometer, which illuminates the sample equally over the hemisphere and which receives reflected energy at specific angles, yields directional reflectance data. Likewise, a total integrating sphere, which illuminates the sample at one angle and collects reflected energy over the whole hemisphere, gives directional reflectance data. Most of the data in ERSIS are examples of directional reflectance, because most, such as the Beckman data, were measured with an integrating sphere attachment.

(3) Degree of Polarization.* The beam is divided into a pair of completely and orthogonally polarized components which have maximum difference in intensity. The dominant component is called I_{max}, and the inferior component called I_{min}. Degree of polarization is then given by

$$\frac{I_{max} - I_{min}}{I_{max} + I_{min}}$$

which is a dimensionless number between 0 and 1. The percentage of polarization is 100 times the degree of polarization. Note: Some investigators such as Coulson define degree of polarization as

$$\frac{I_{\perp} - I_{\parallel}}{I_{\perp} + I_{\parallel}}$$

which permits negative values, depending on the relative sizes of $I_{\perp}$ and $I_{\parallel}$.

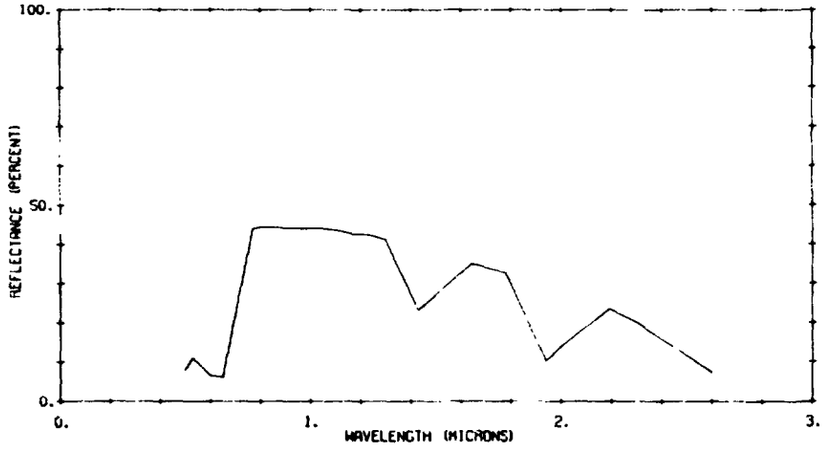
*Definition from W. A. Shurcliff, Polarized Light, Harvard University Press, Cambridge, Mass., 1965.

61K4
RED OAK

(See page 61K4-95 and following pages for Further Comments on Document B09007, the source of all of Red Oak spectral curves included in this section)

B09007 001

TREE 1, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



B09007 002

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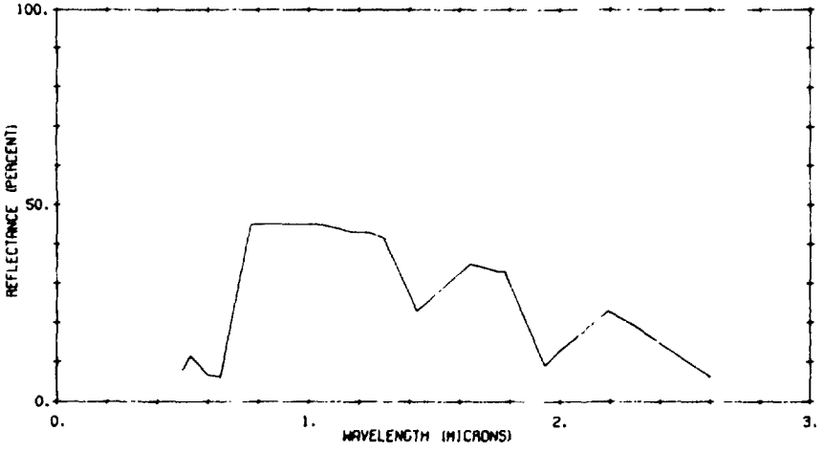

B09007 003

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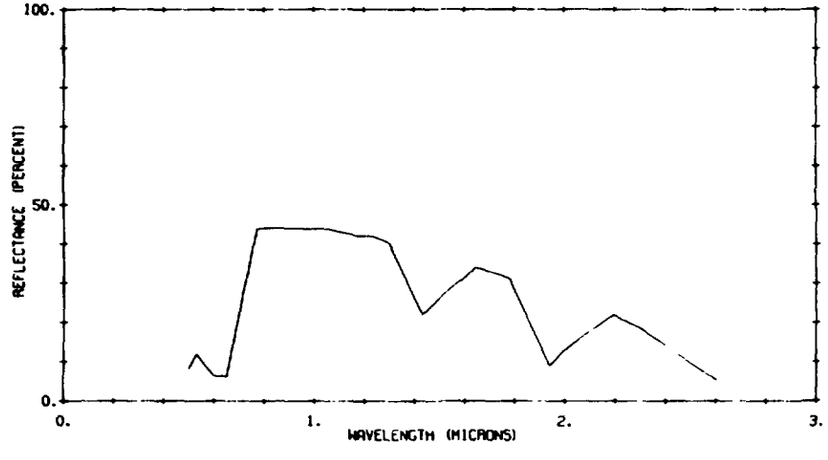

B09007 004

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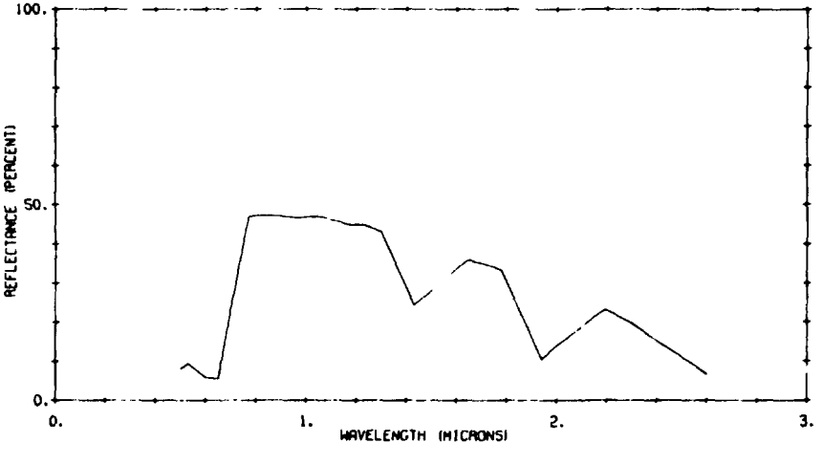

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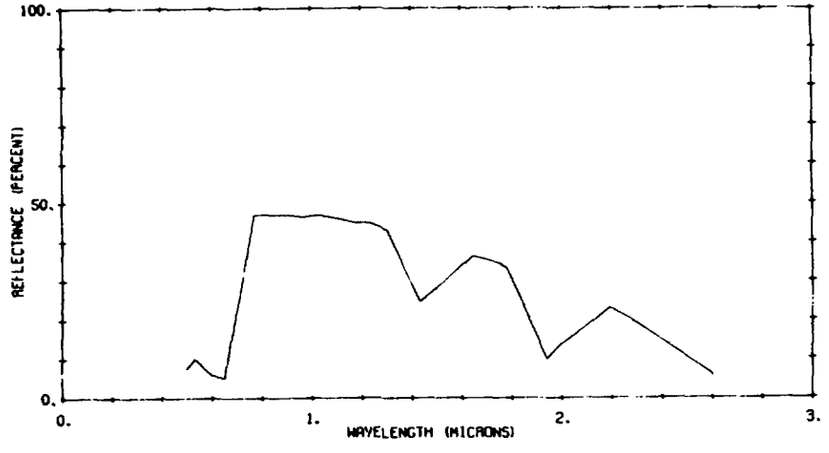

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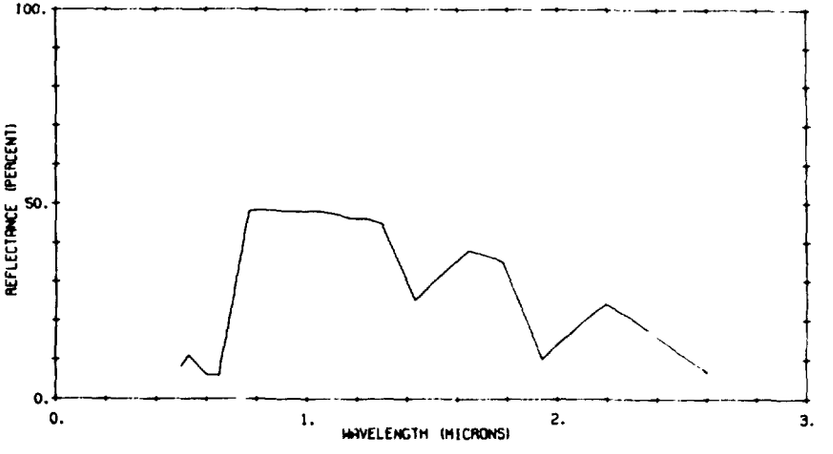

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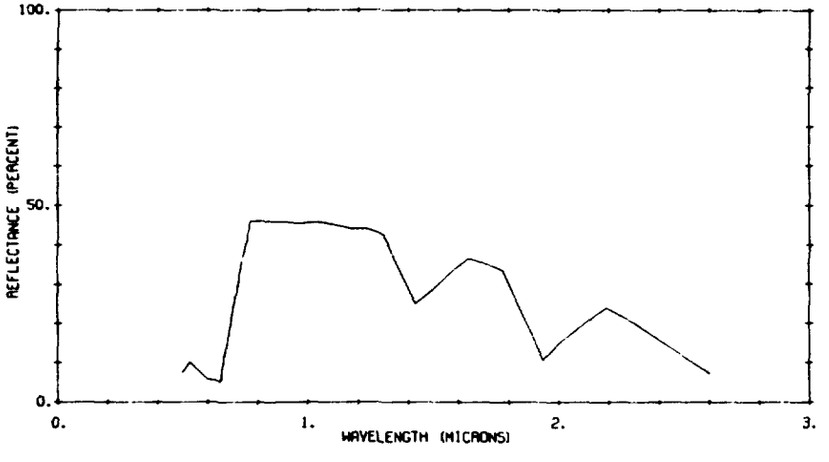

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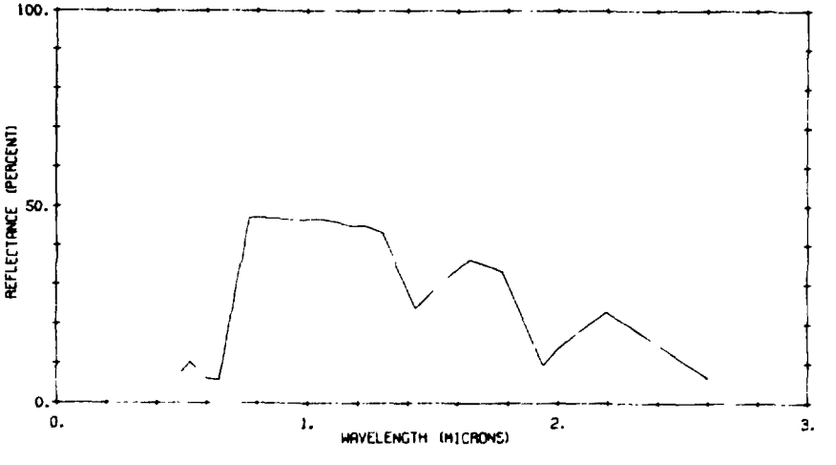

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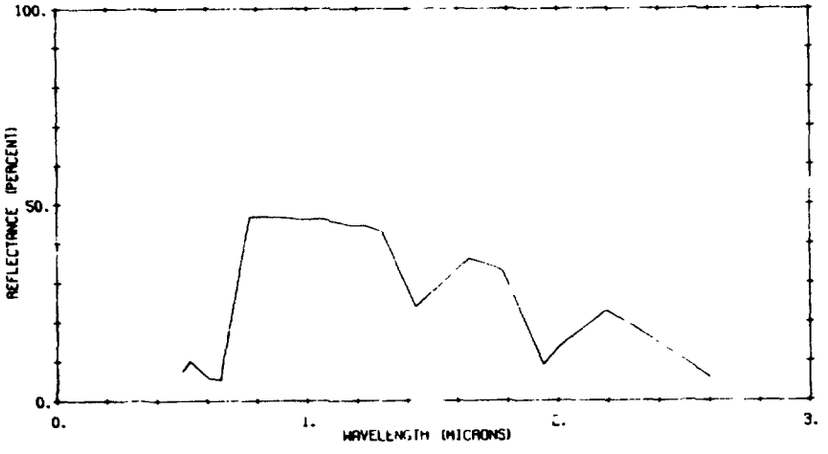

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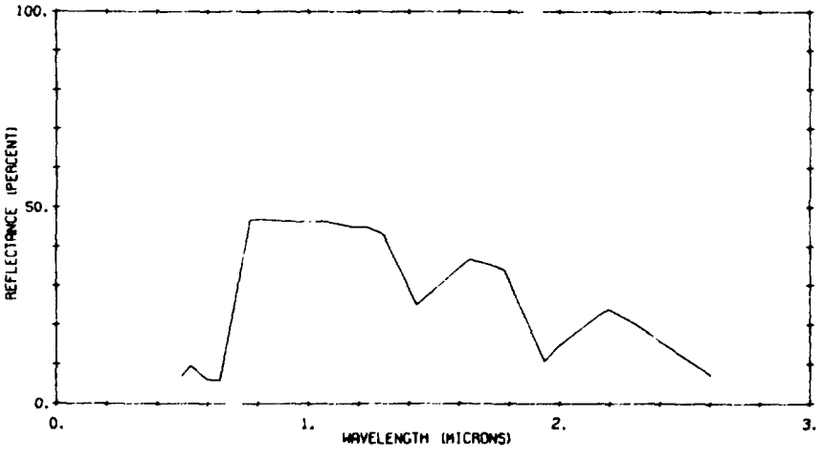

B09007 011

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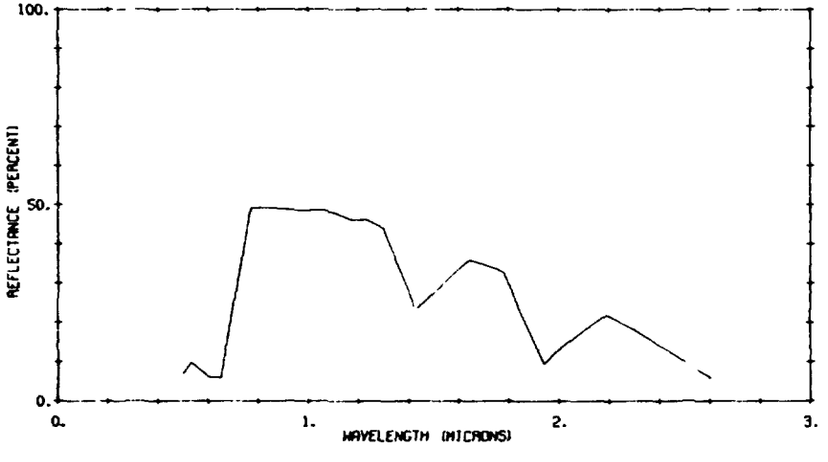

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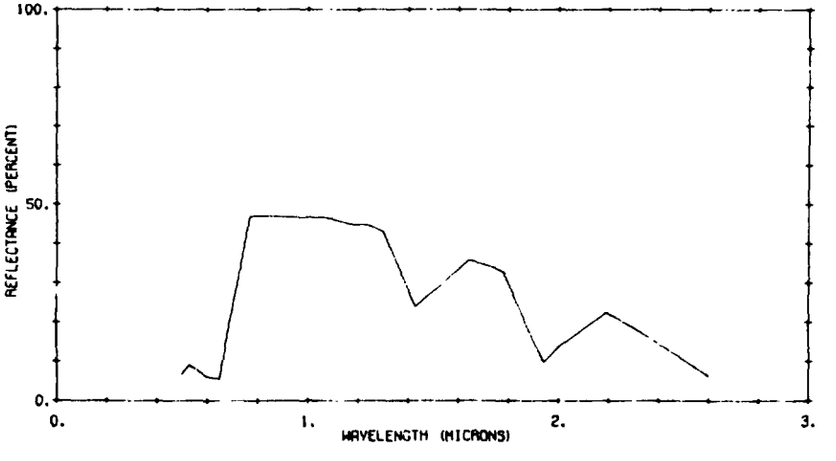

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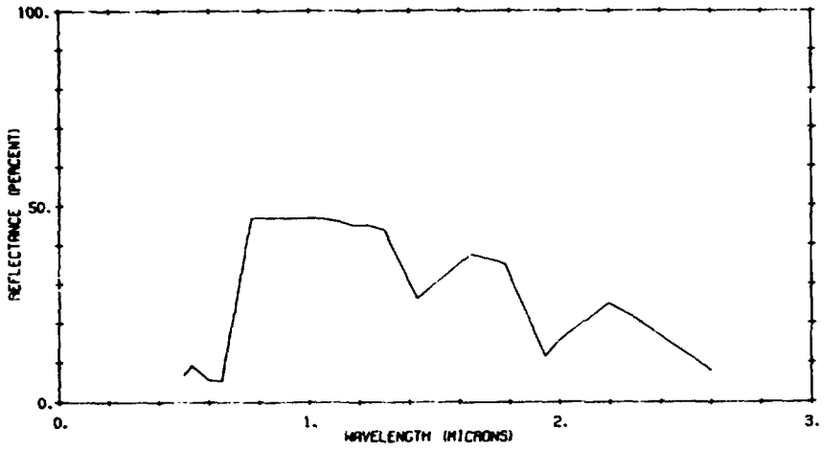

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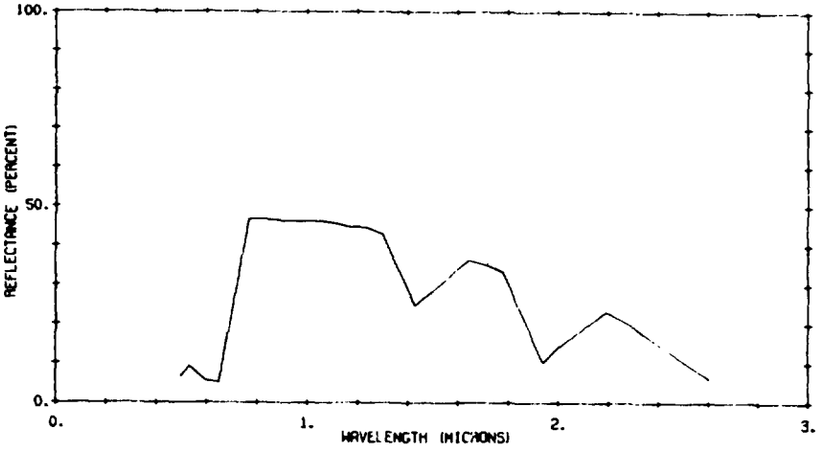

B09007 015

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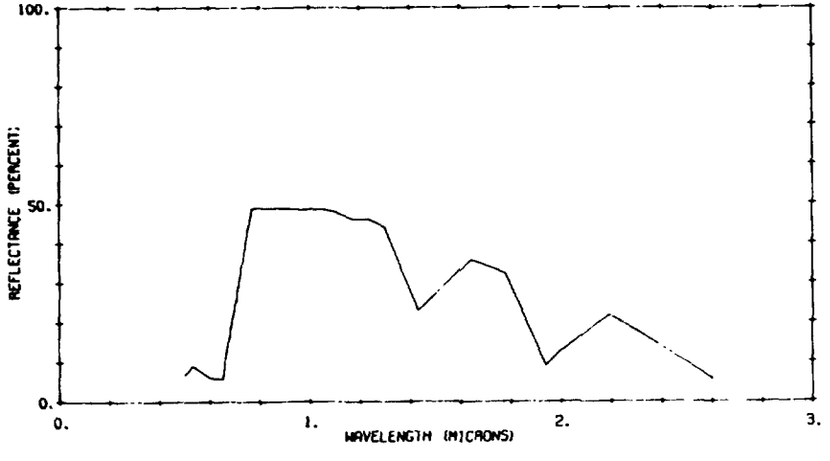

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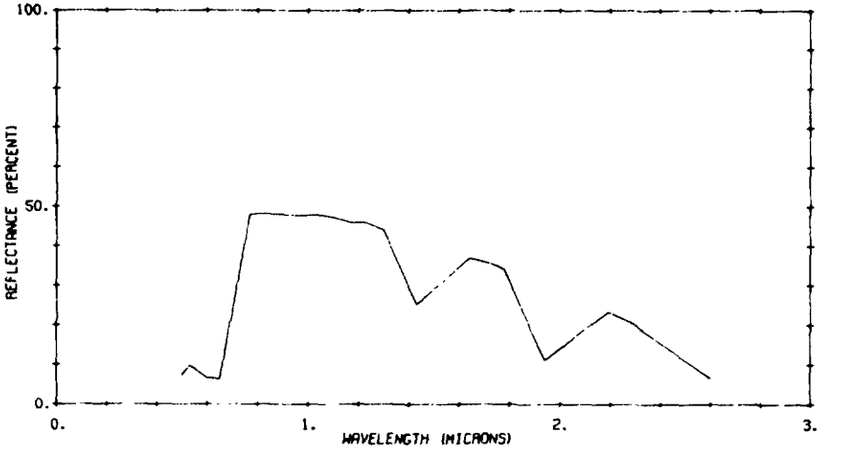

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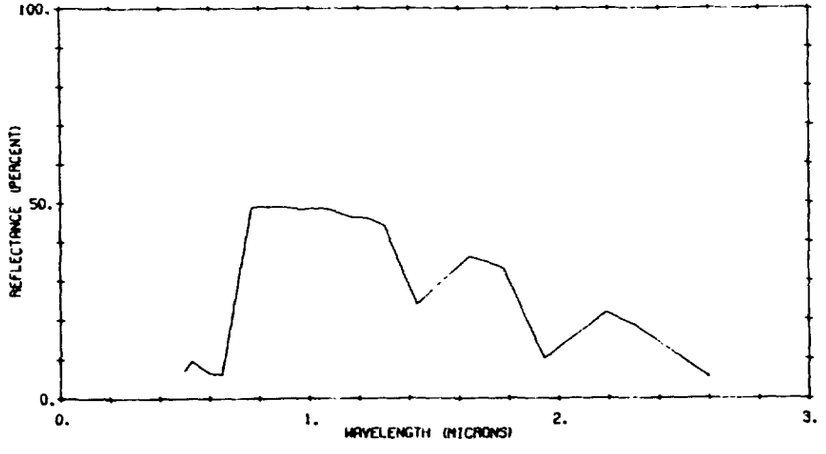

B09007 018

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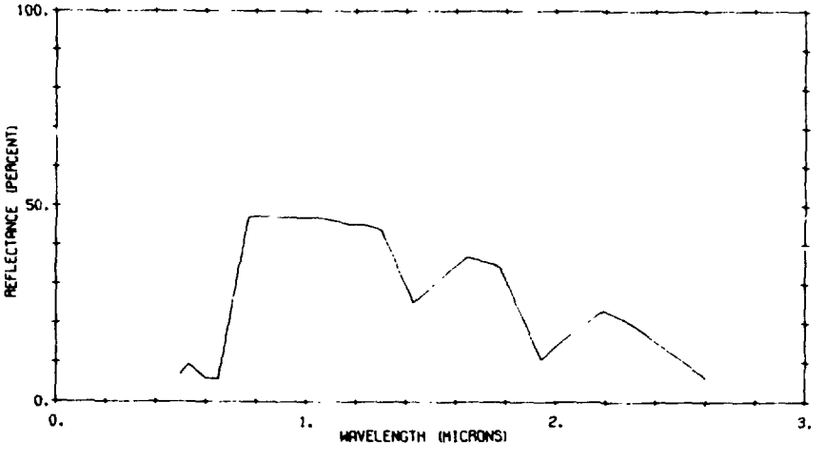

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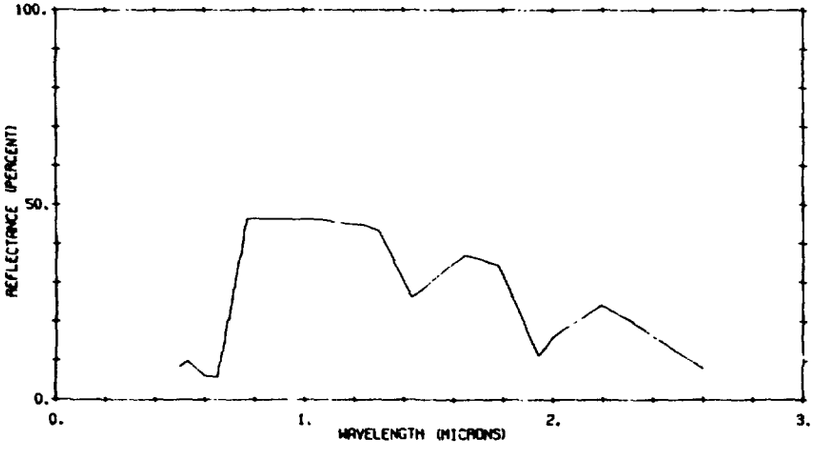

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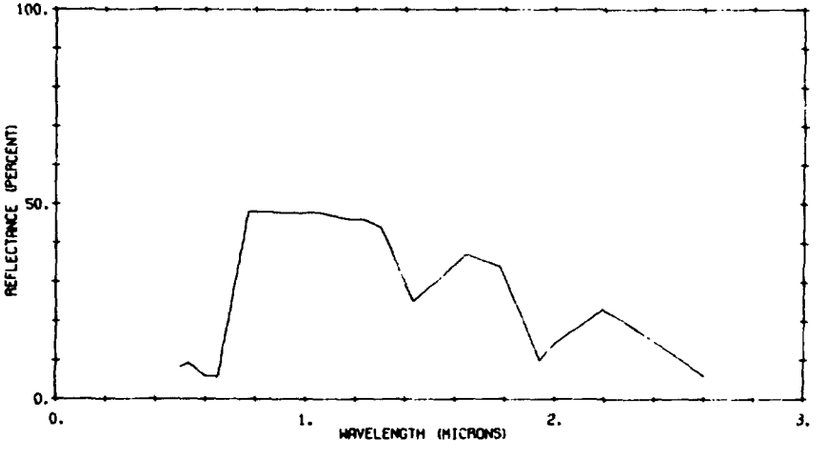

B09007 021

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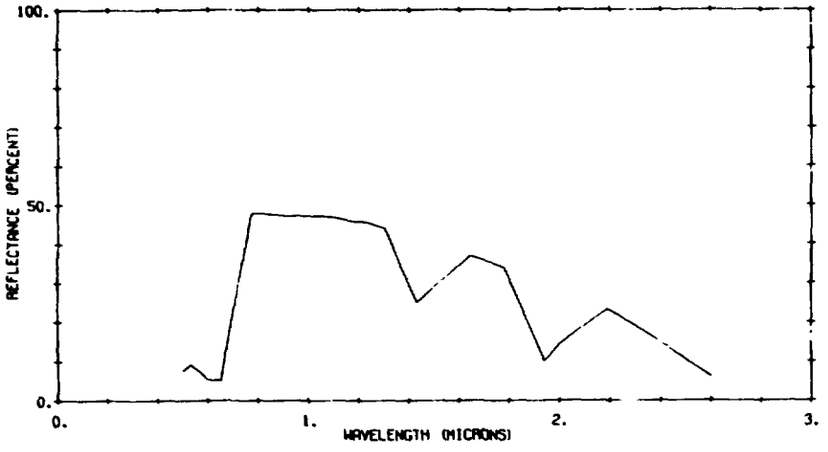

B09007 022

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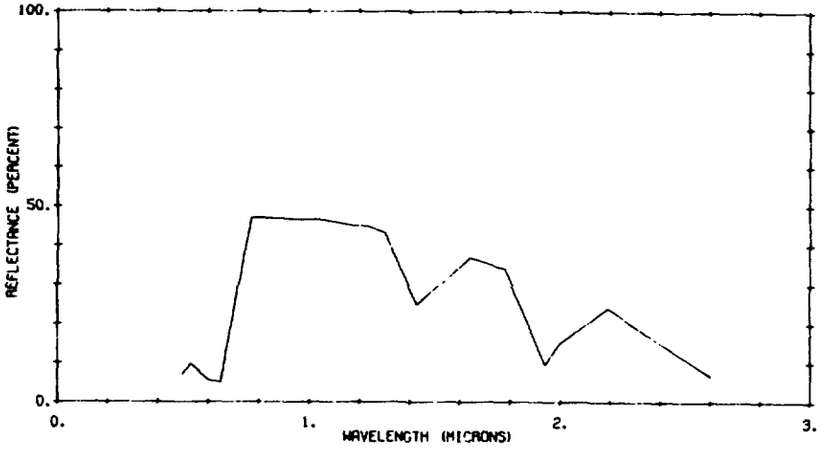

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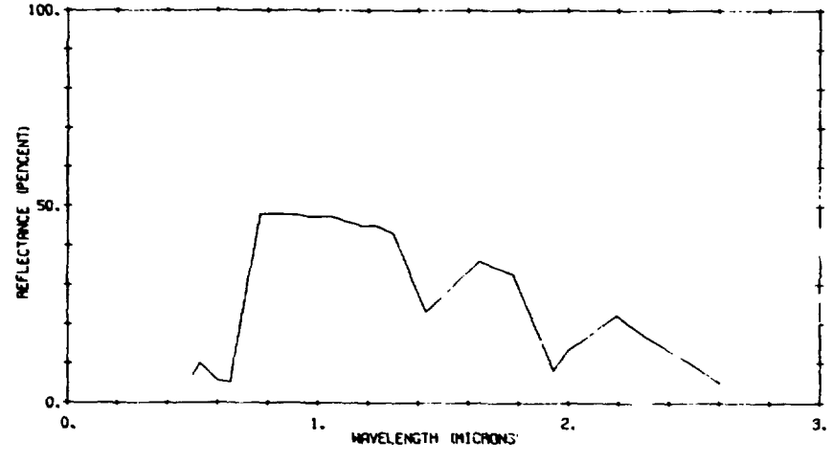

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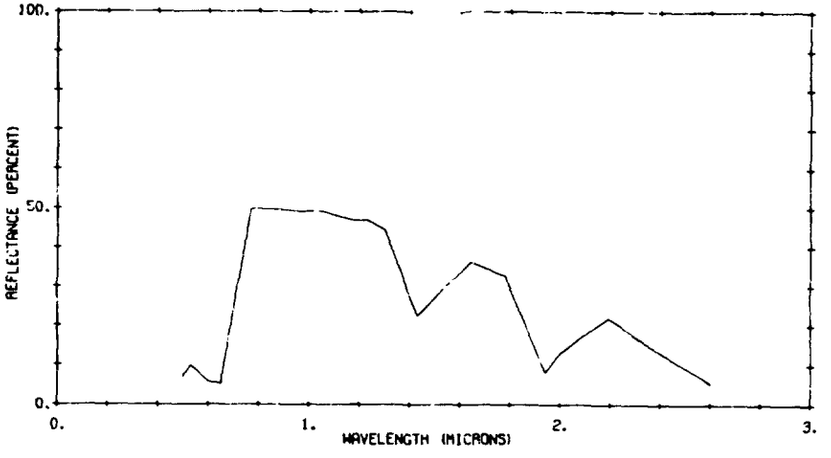

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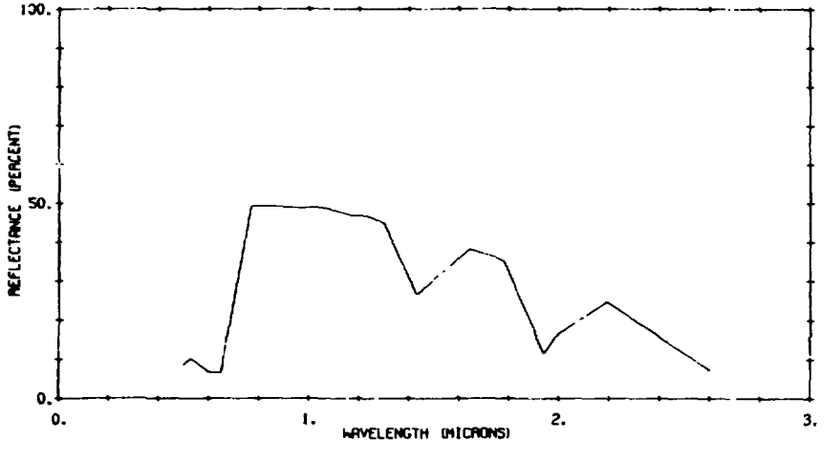

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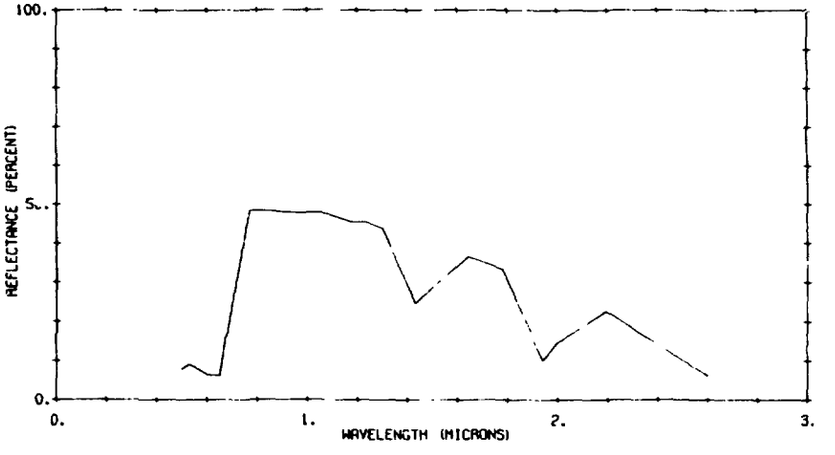

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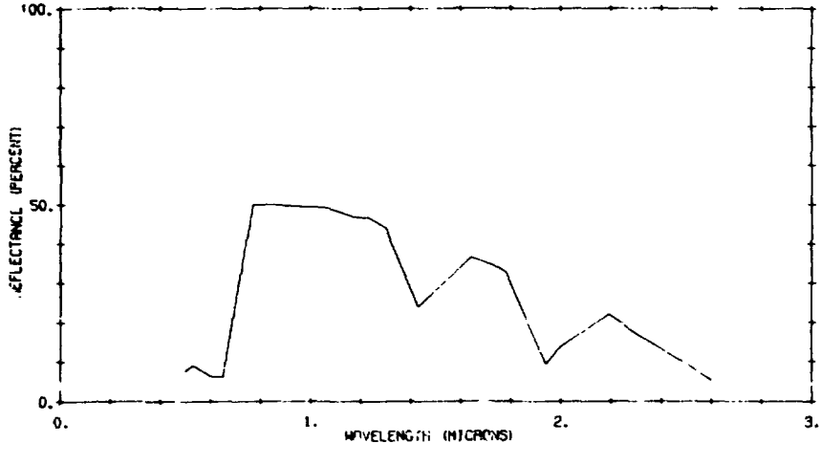

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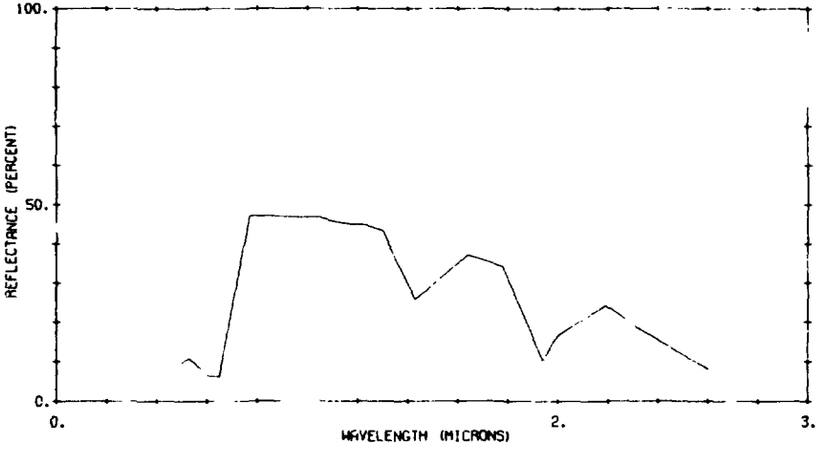

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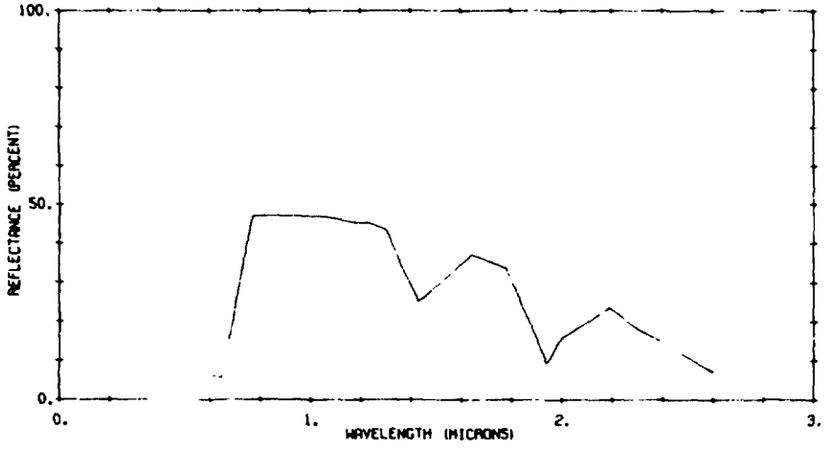

B09007 030

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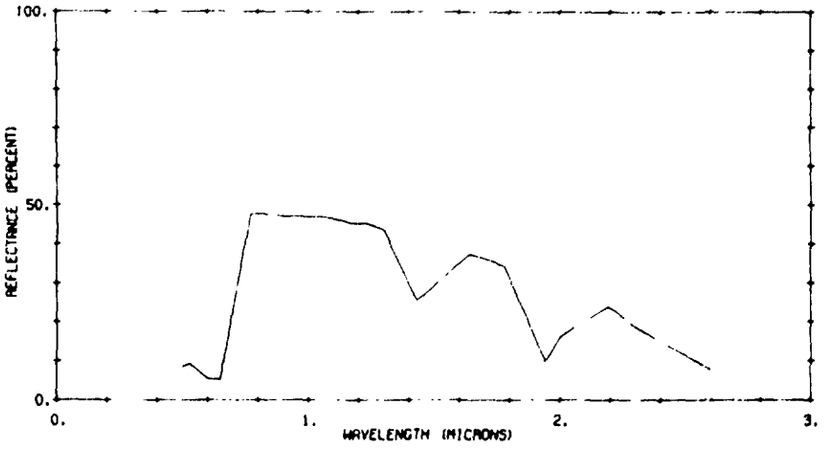

B09007 031

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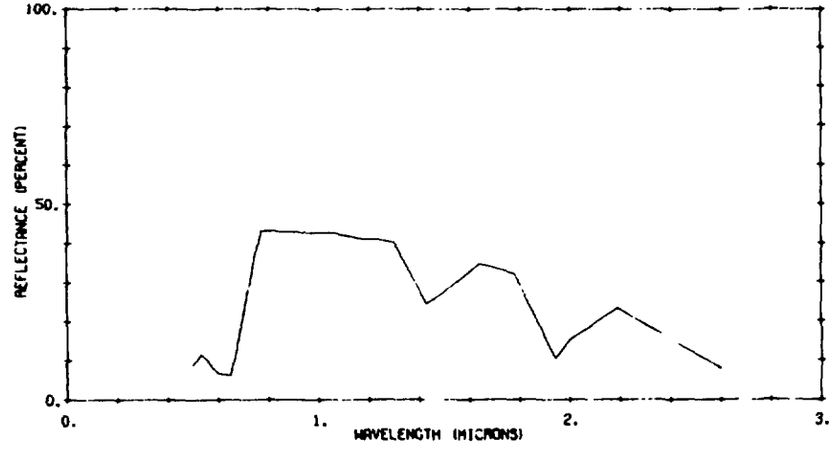

B09007 032

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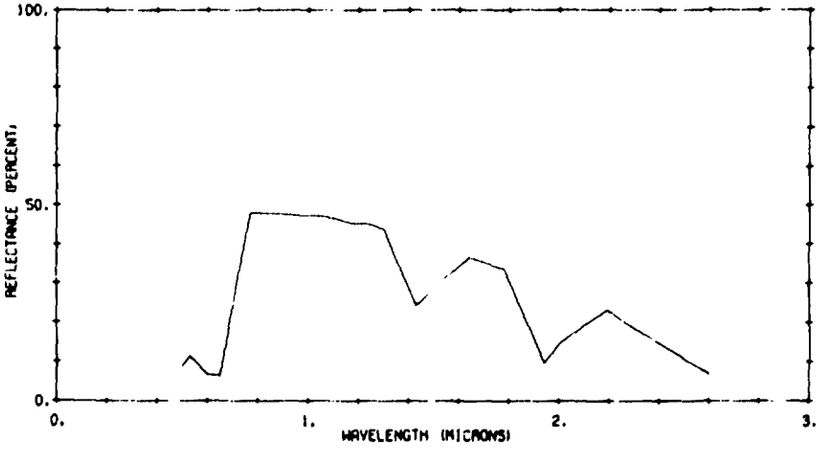

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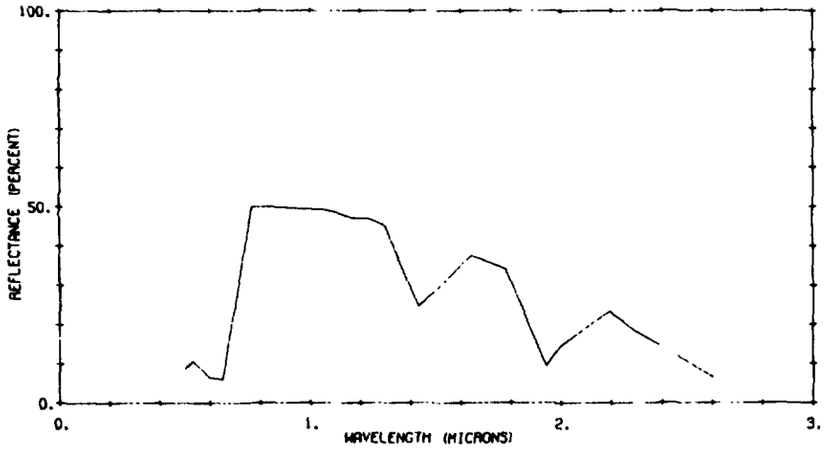

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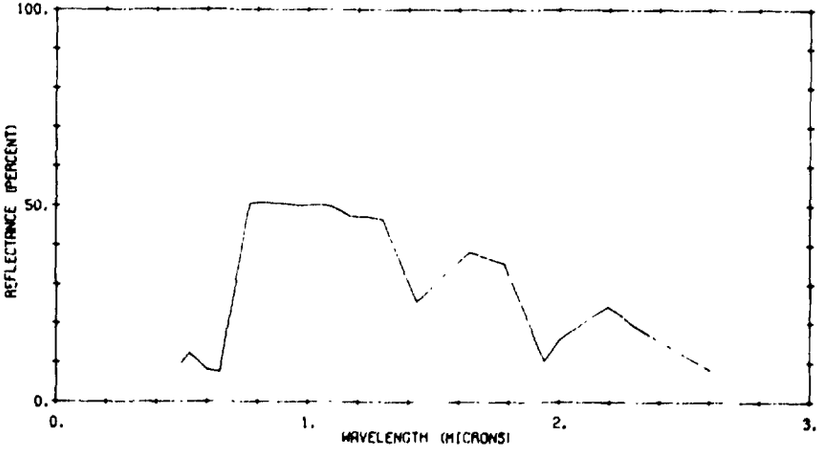

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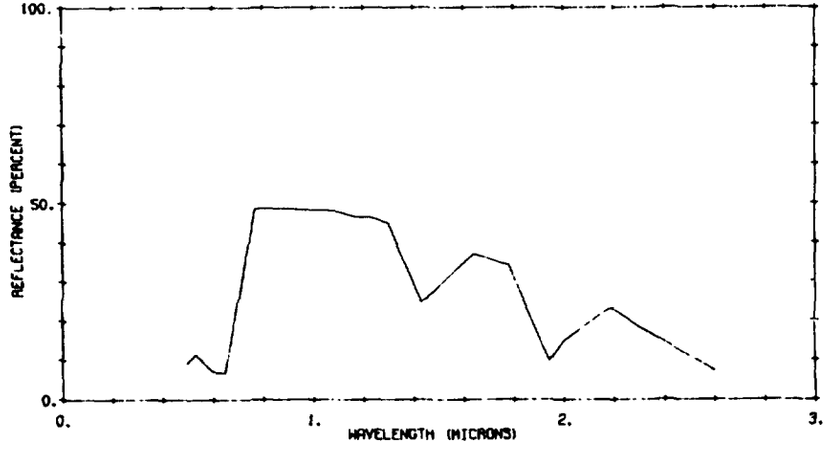

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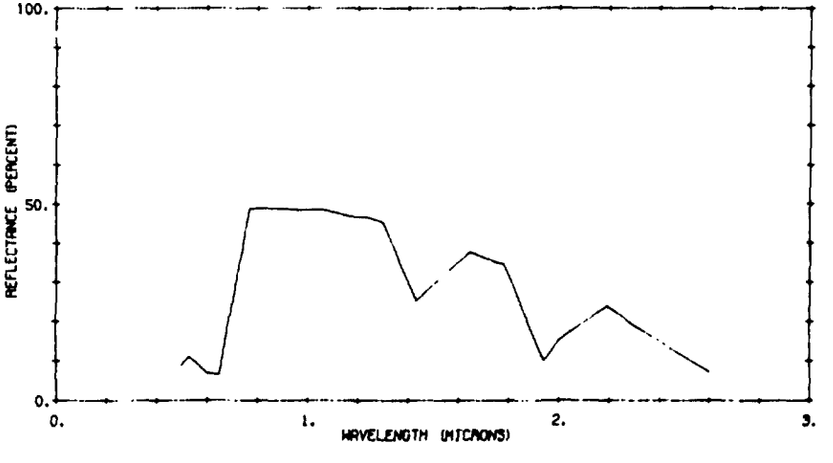

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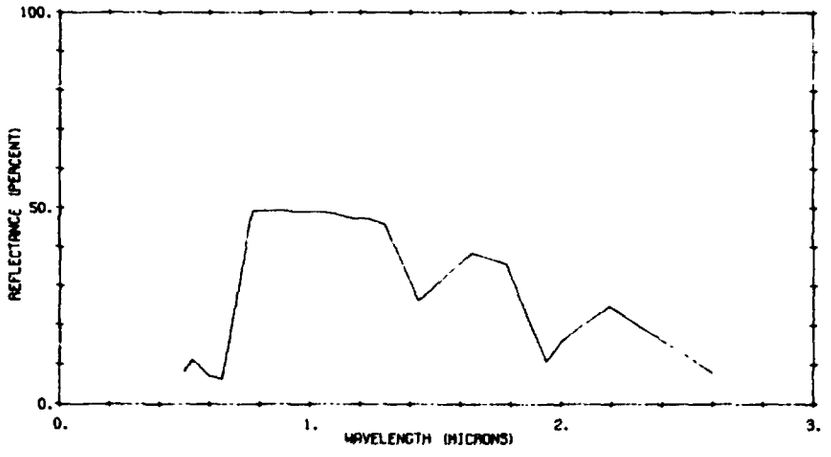

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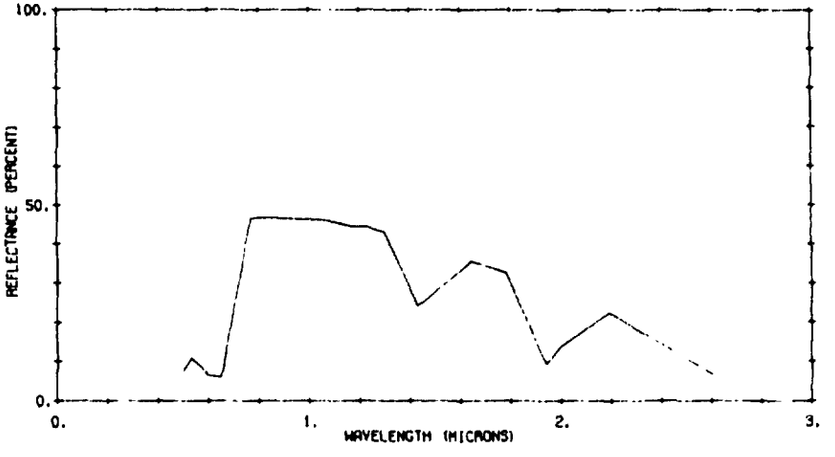

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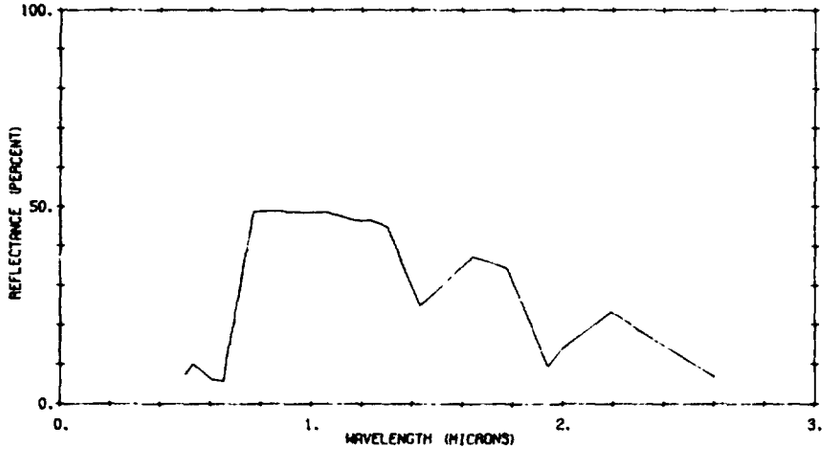
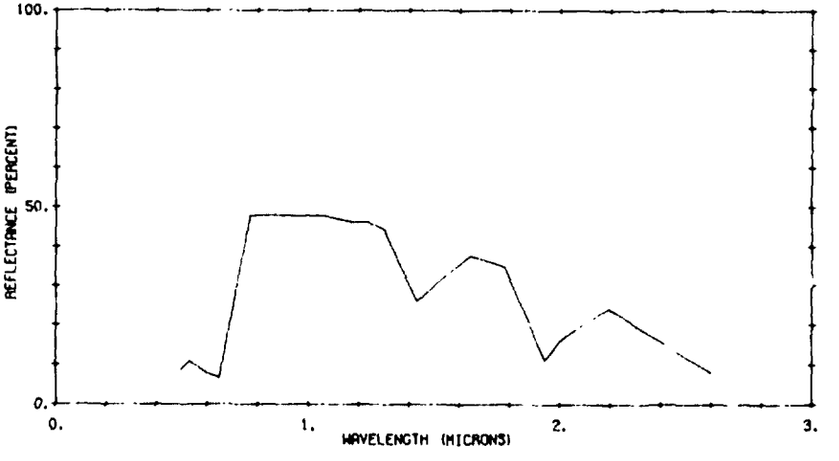


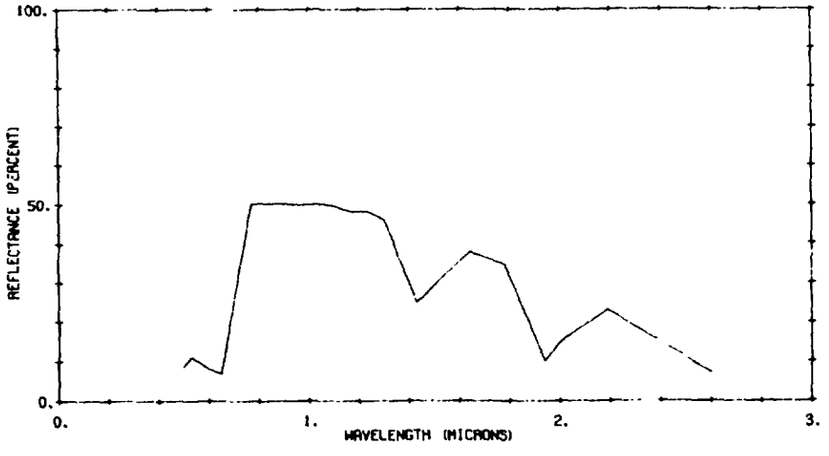
B09007 040

TREE 1, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



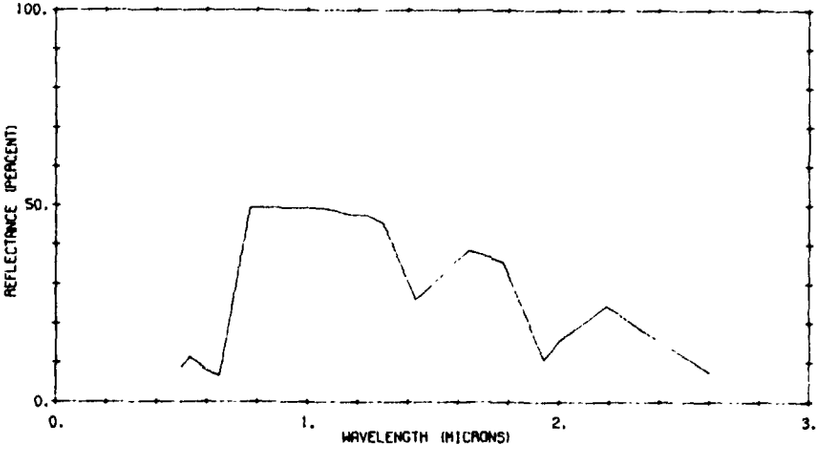
B09007 041

TREE 1, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



B09007 042

TREE 1, LEAF 3 WATERED EVERY SECOND OR THIRD DAY



B09007 043

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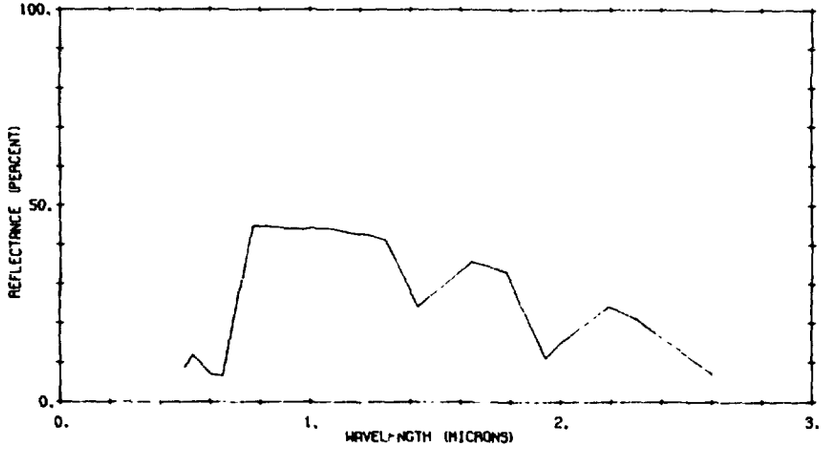
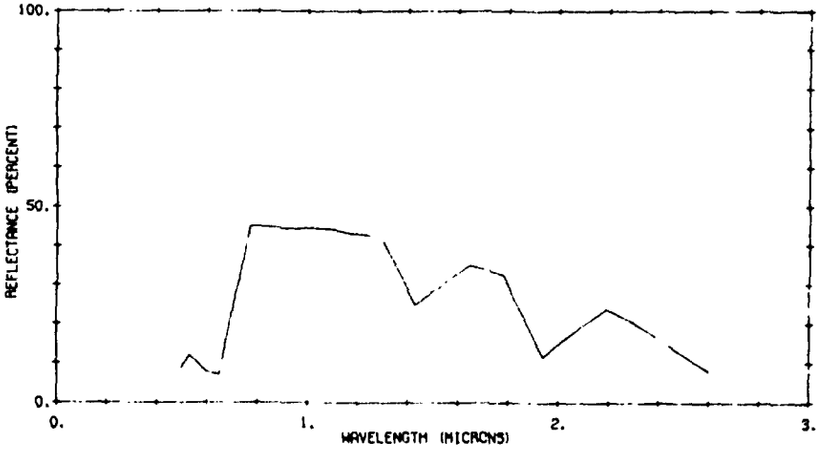


B09007 044

TREE 2, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



B09007 045

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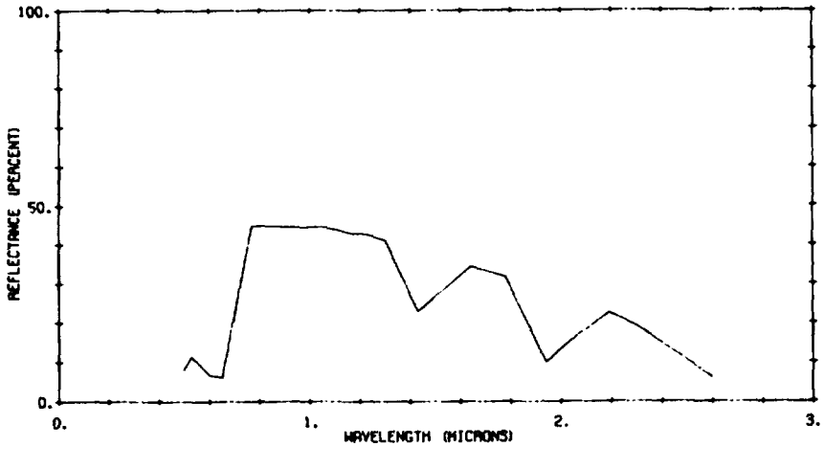

B09007 046

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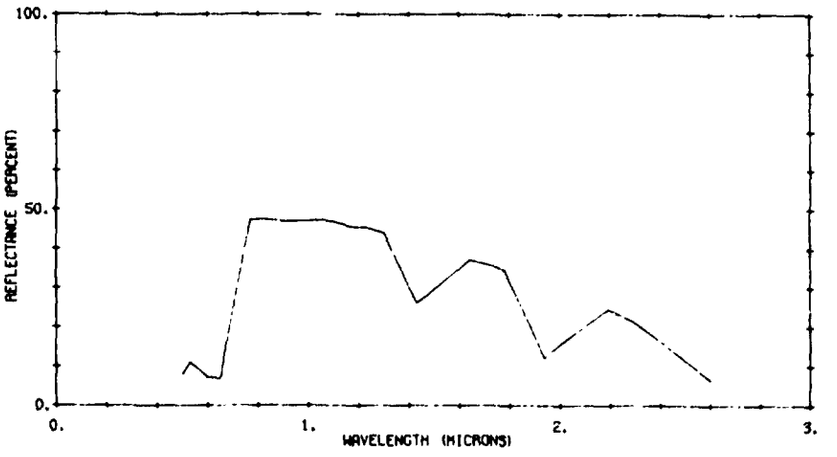
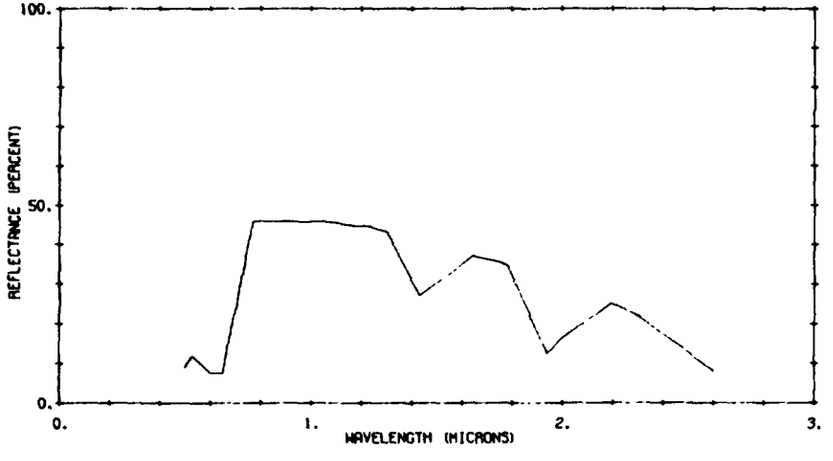


B09007 047

TREE 2, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



B09007 048

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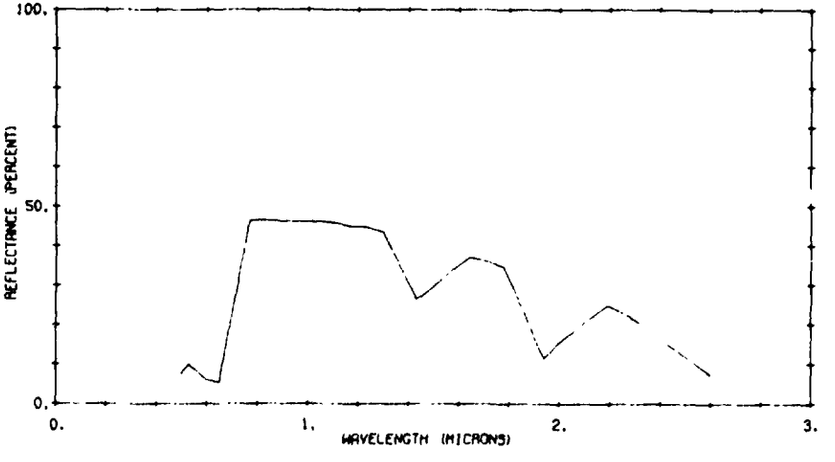

B09007 049

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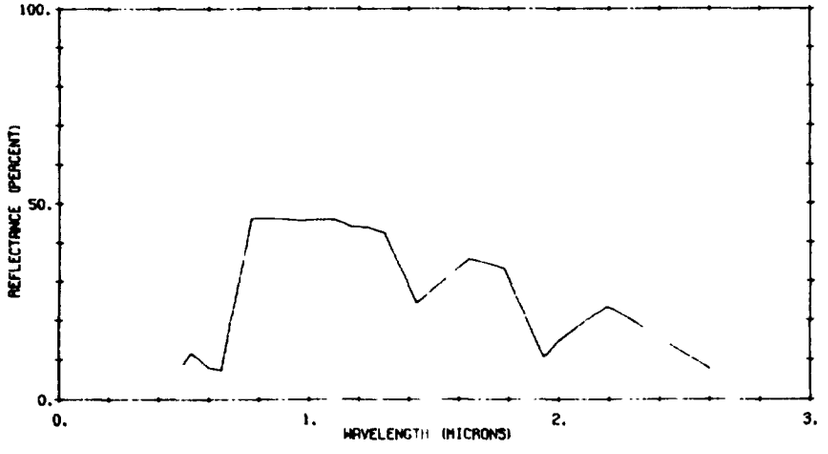

B09007 050

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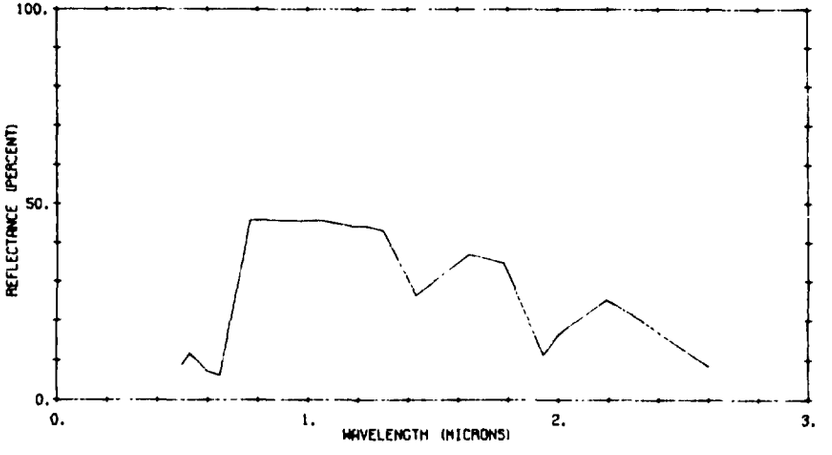

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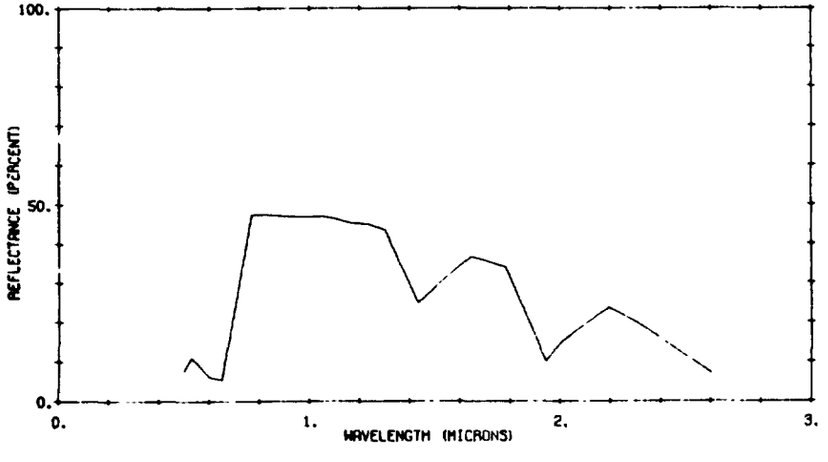
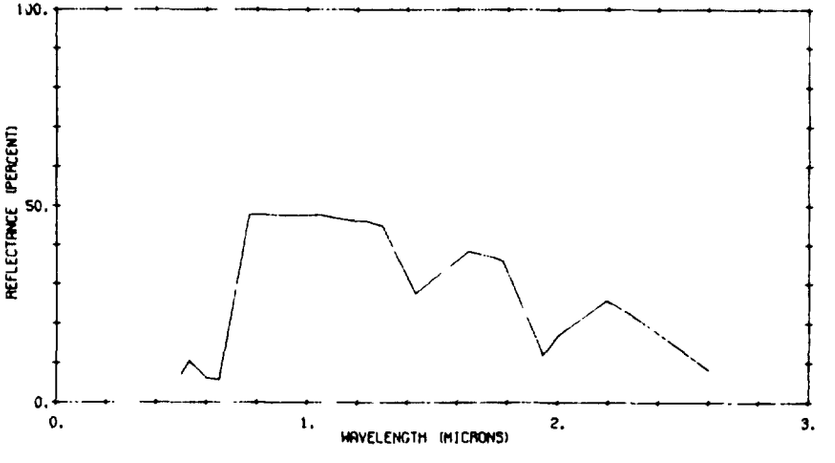


B09007 052

THEE 2, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



B09007 053

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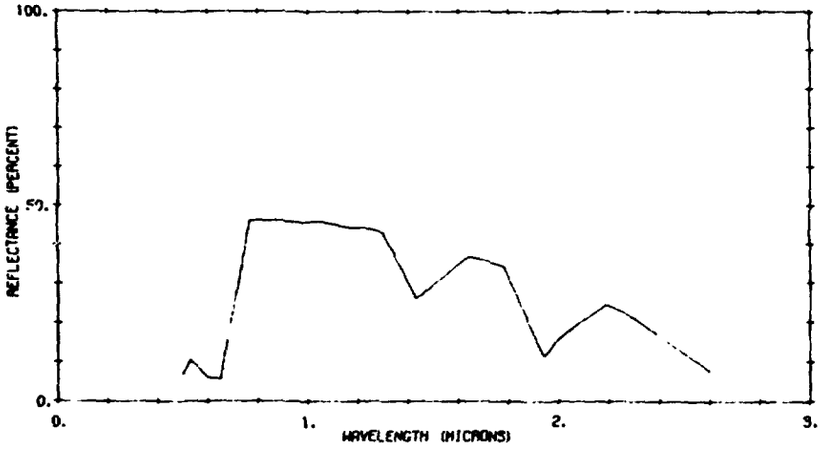

B09007 054

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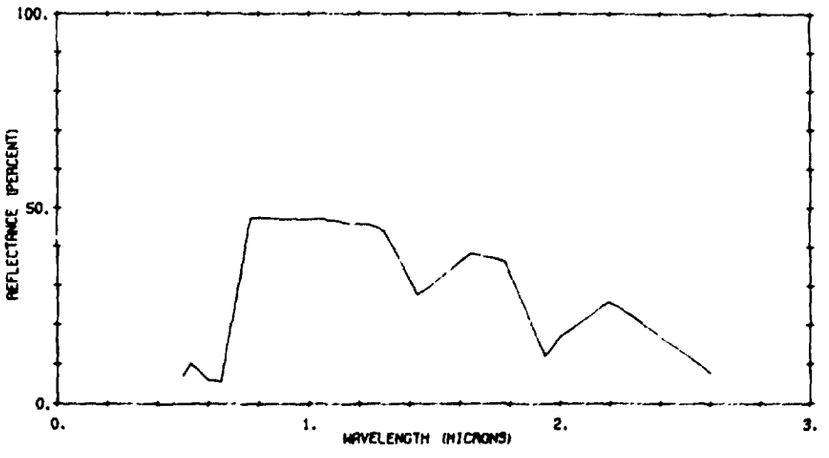

B09007 055

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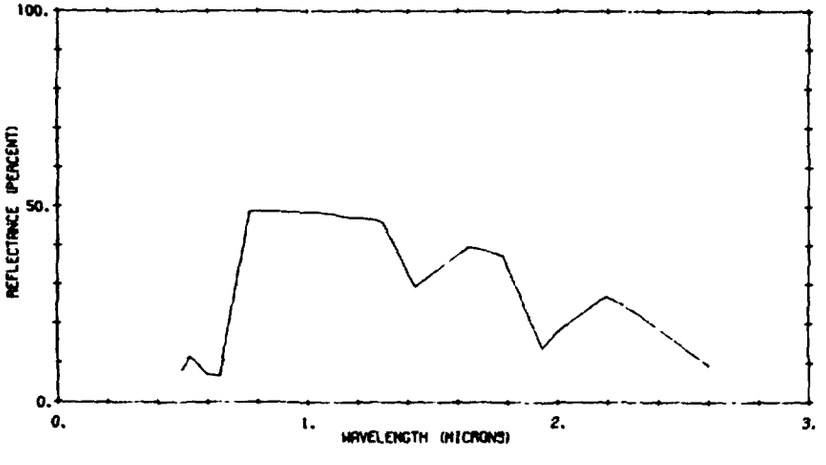

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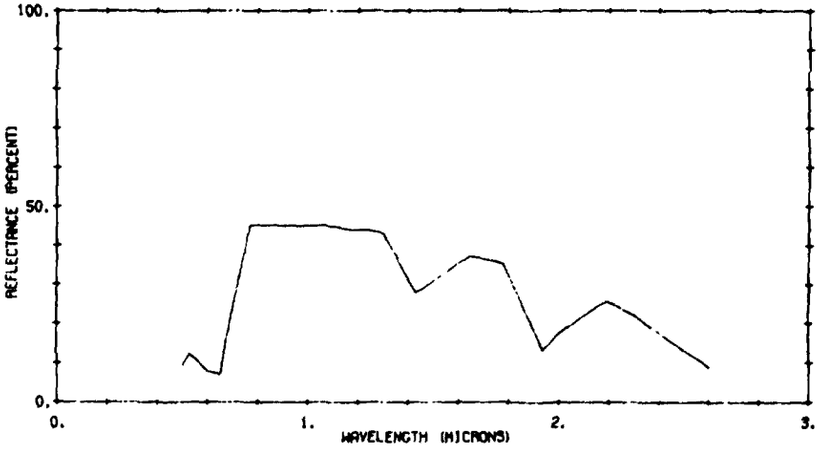

B09007 057

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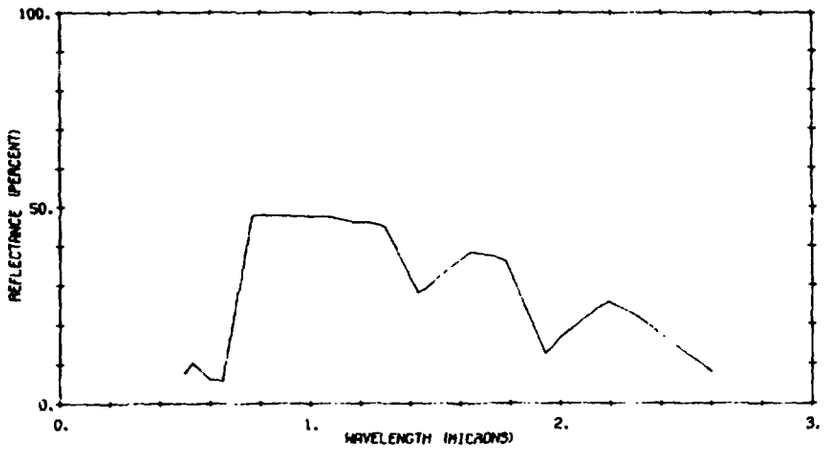

B09007 058

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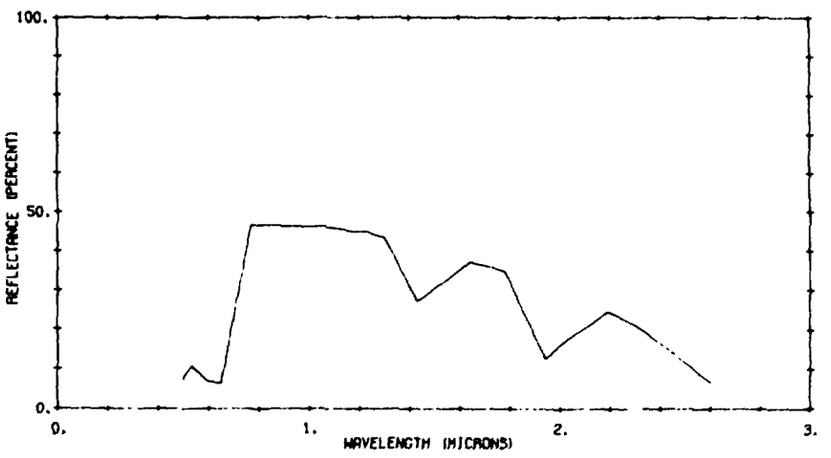

B09007 059

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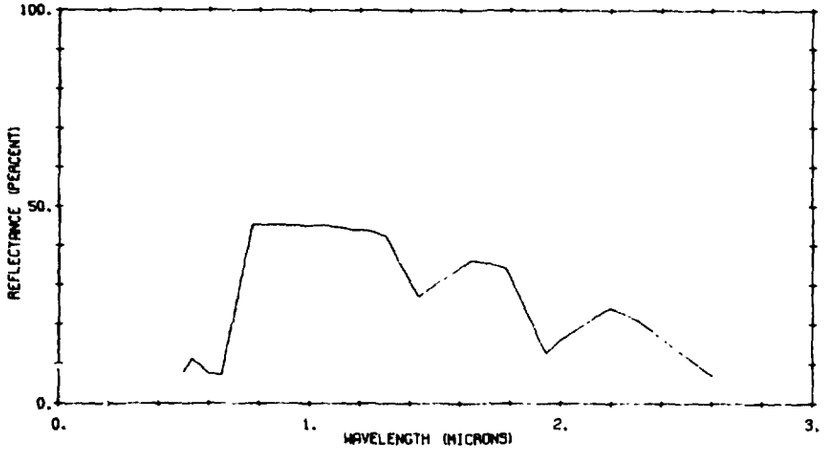

B09007 060

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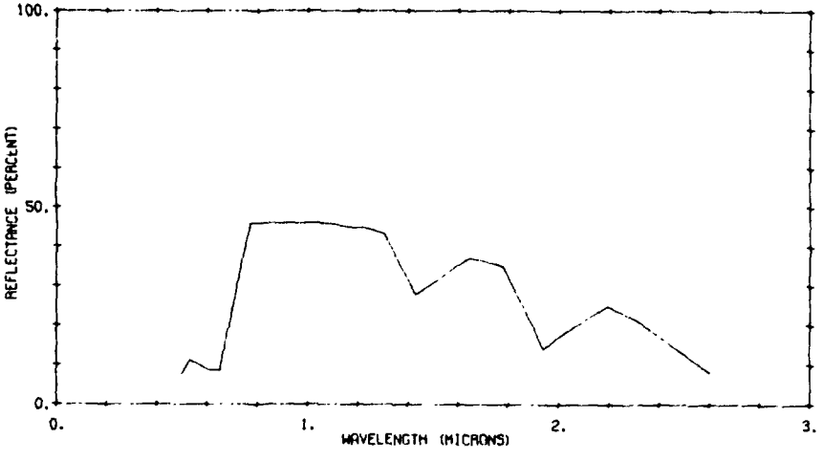

B09007 061

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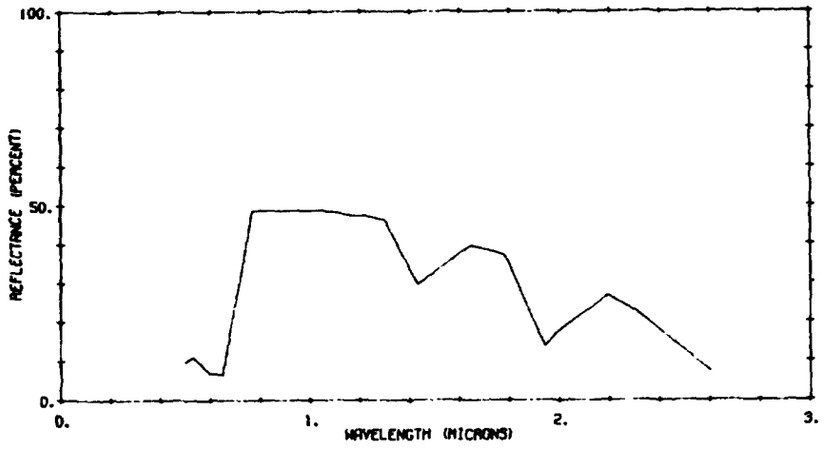

B09007 062

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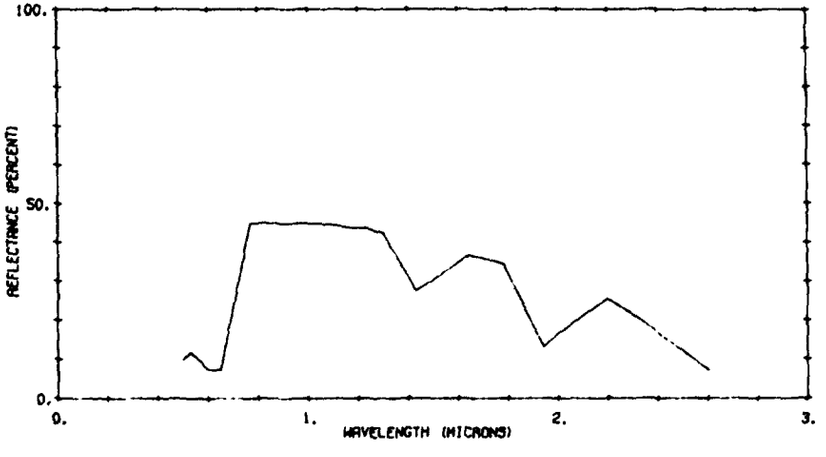

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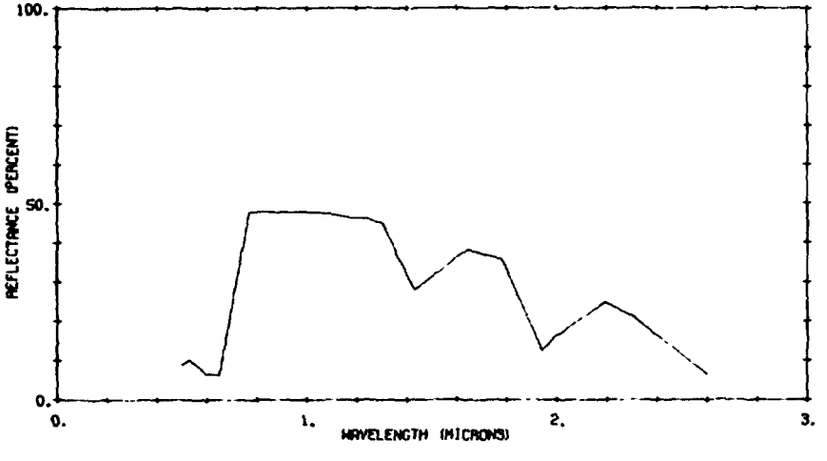

B09007 064

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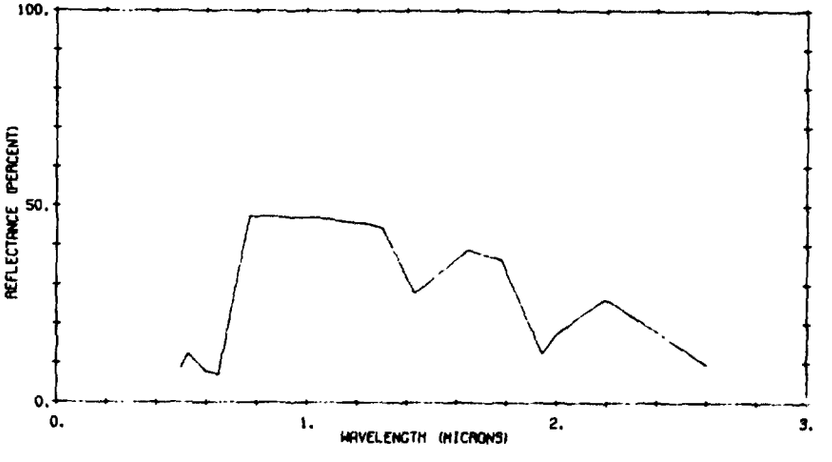

B09007 065

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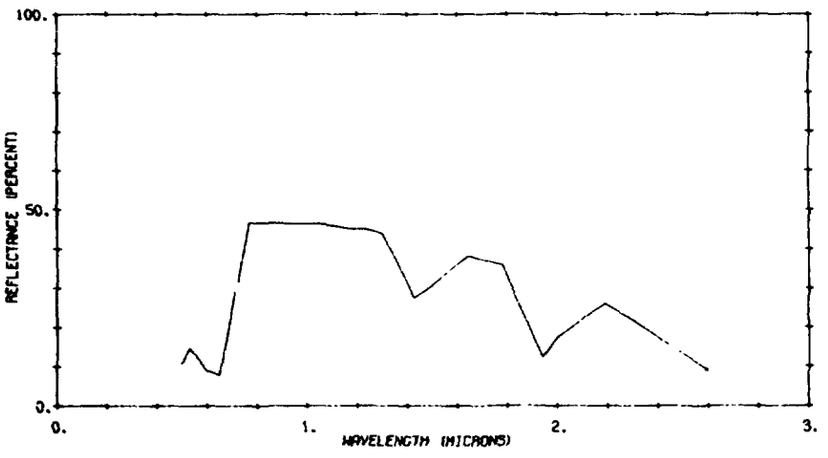

B09007 066

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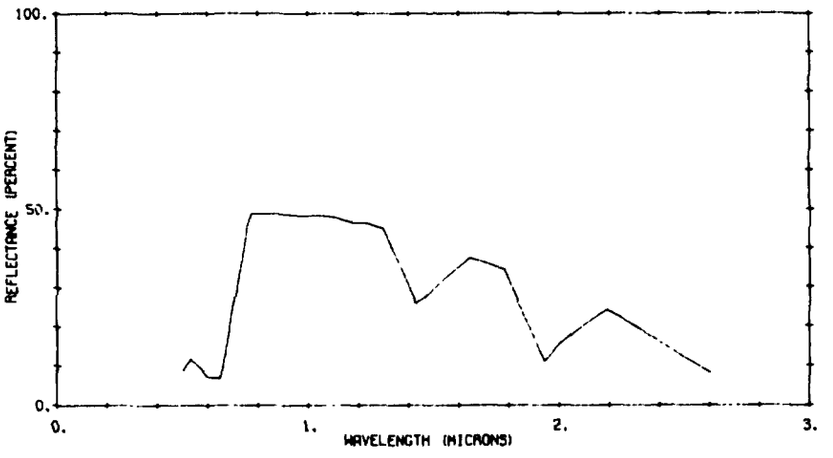

B09007 067

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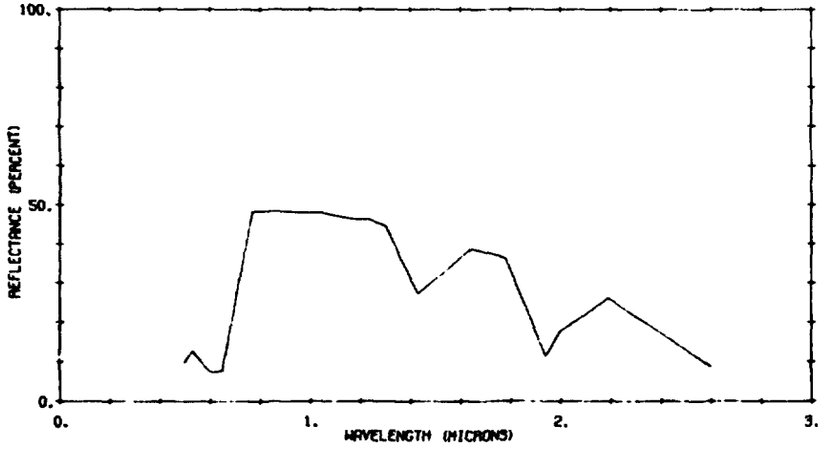

B09007 068

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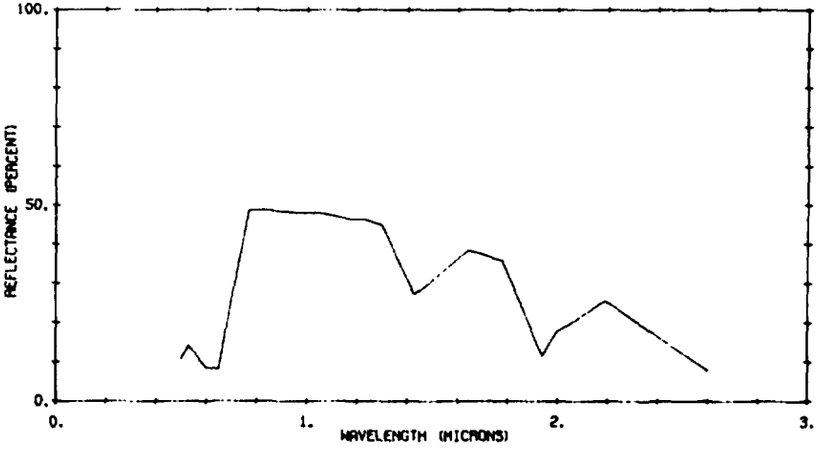

B09007 069

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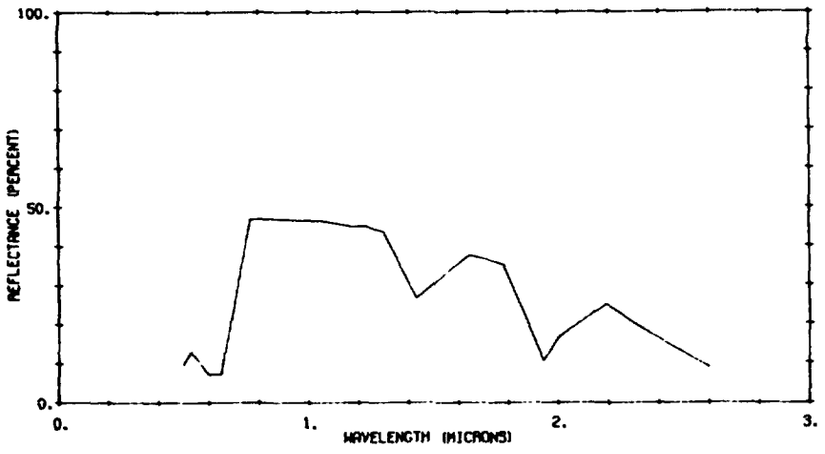

B09007 070

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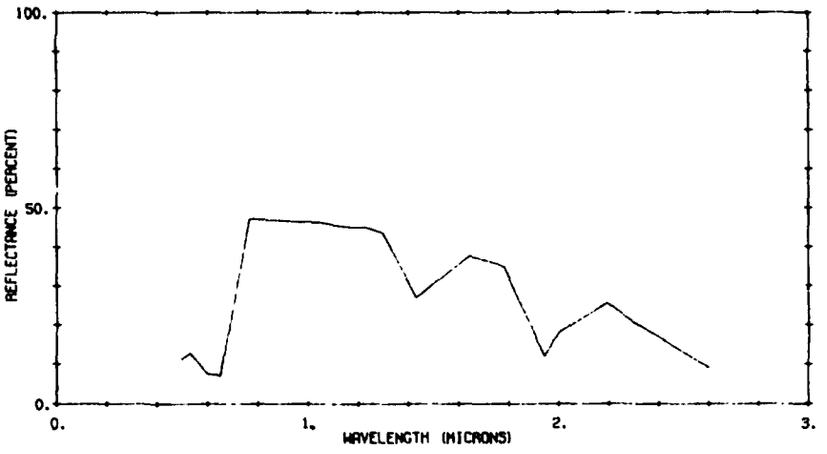

B09007 071

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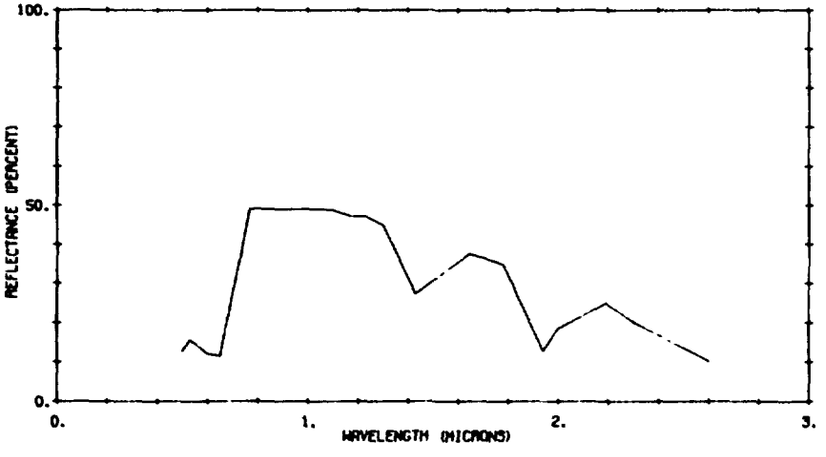

B09007 072

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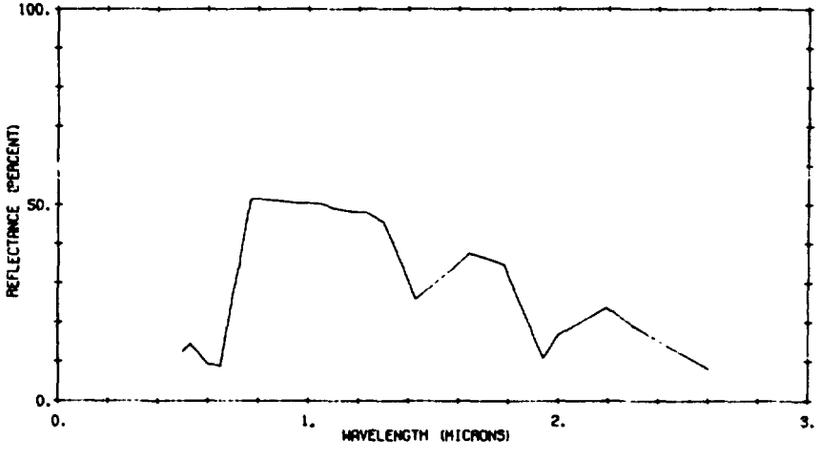

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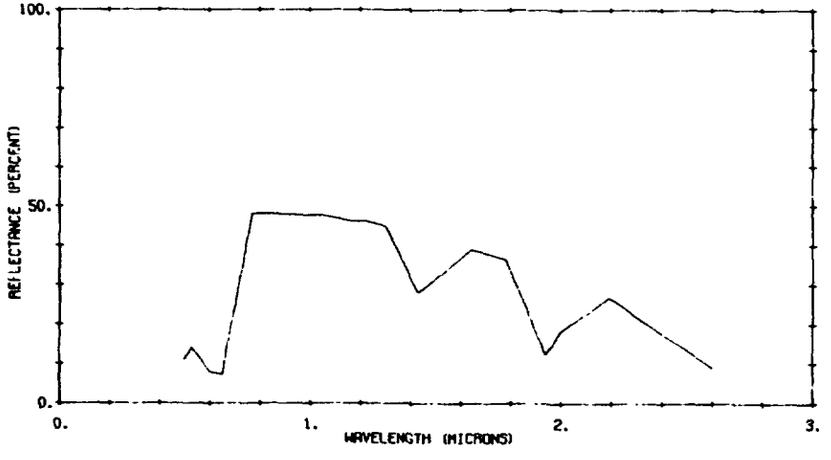

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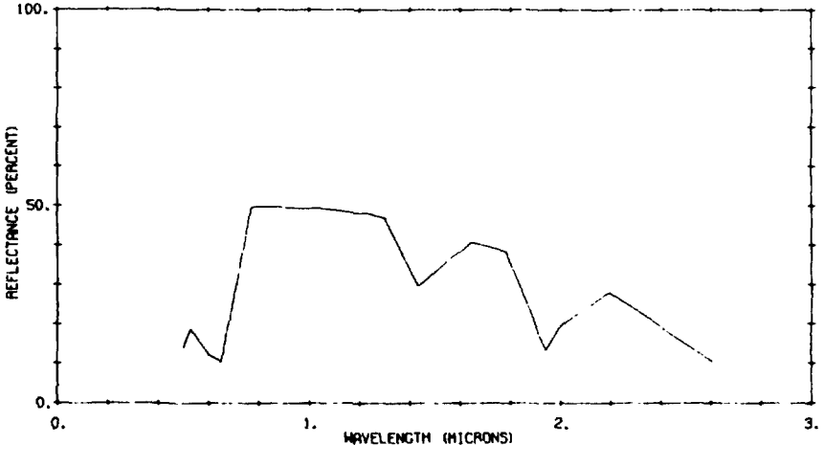

B09007 075

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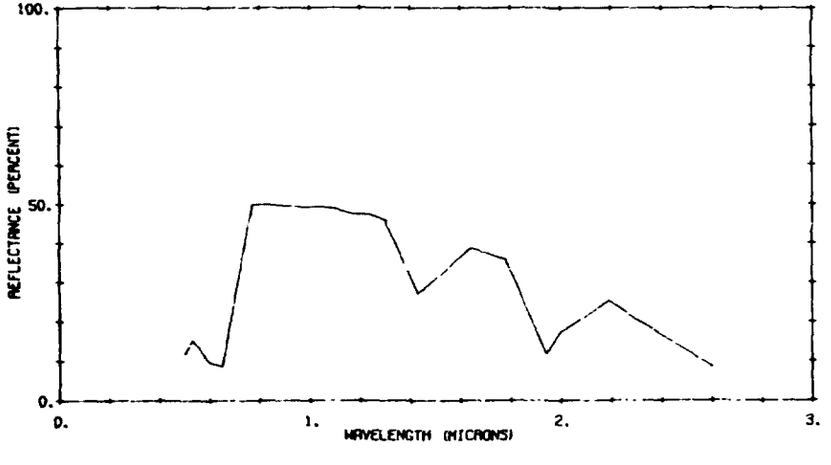

B09007 076

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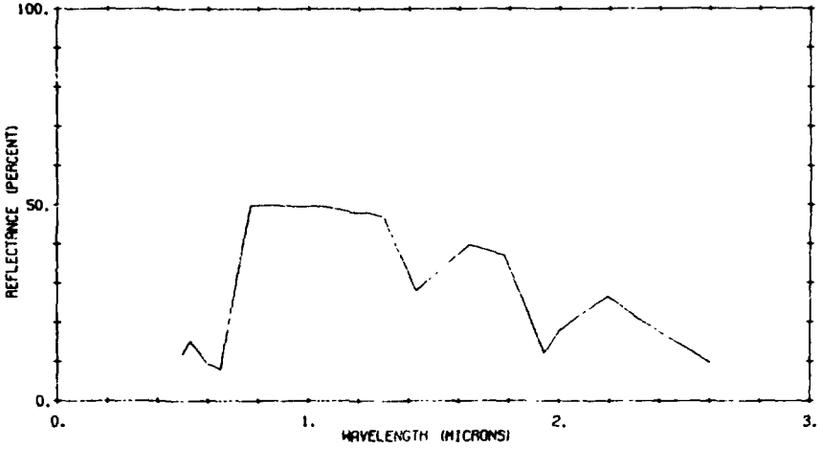
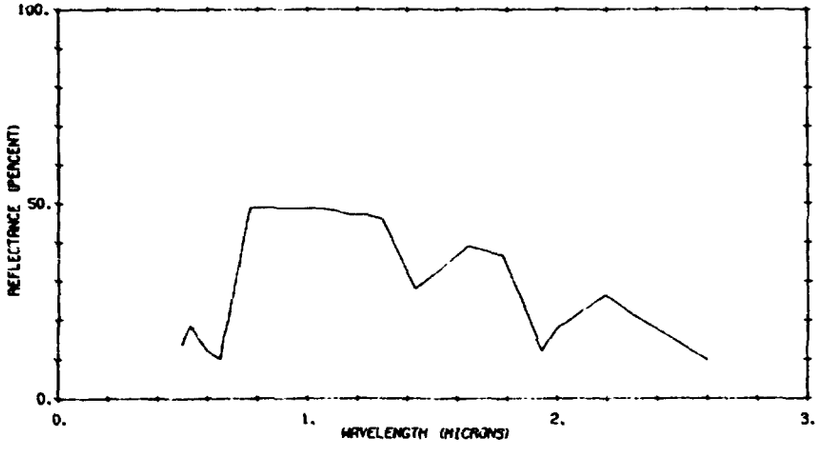


B09007 077

TREE 2, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



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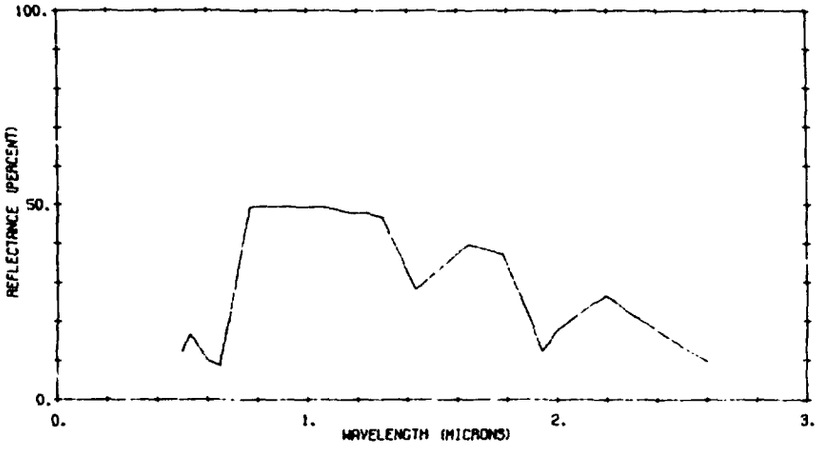
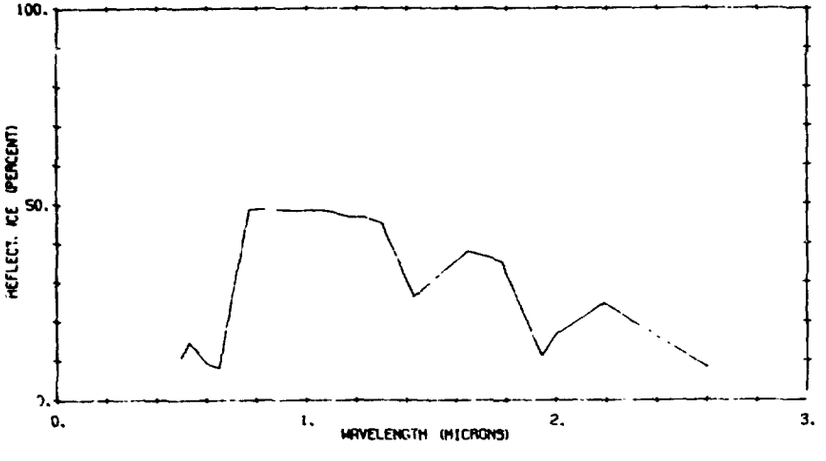


B09007 079

TREE 2, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



B09007 080

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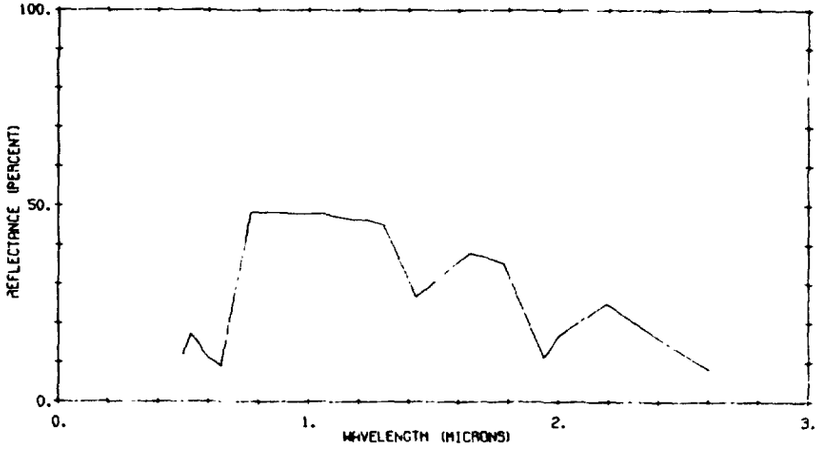

B09007 081

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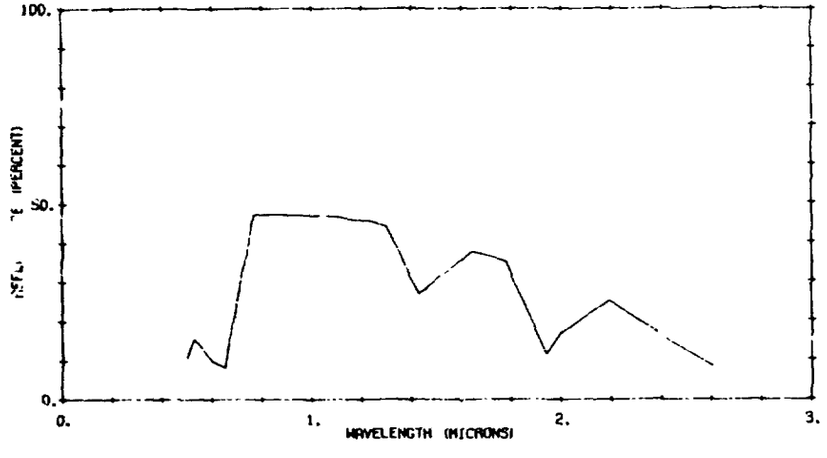

B09007 082

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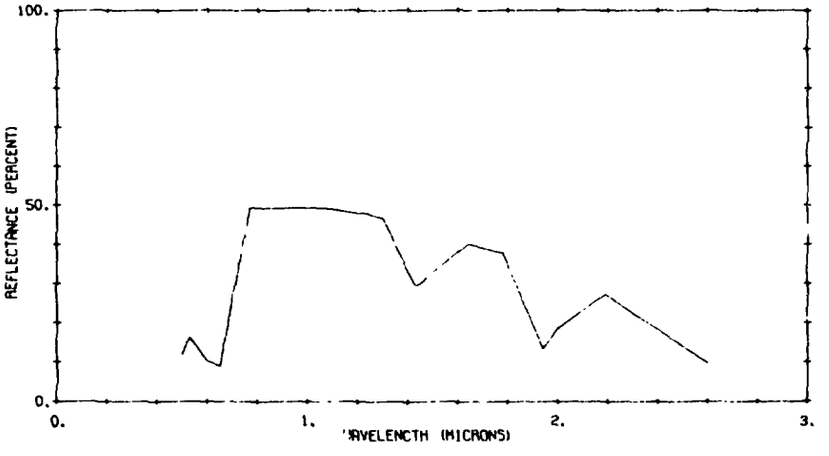

B09007 083

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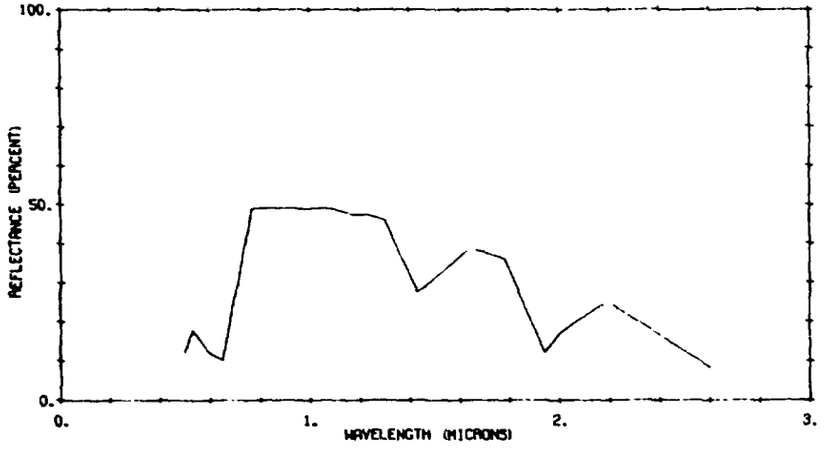

B09007 084

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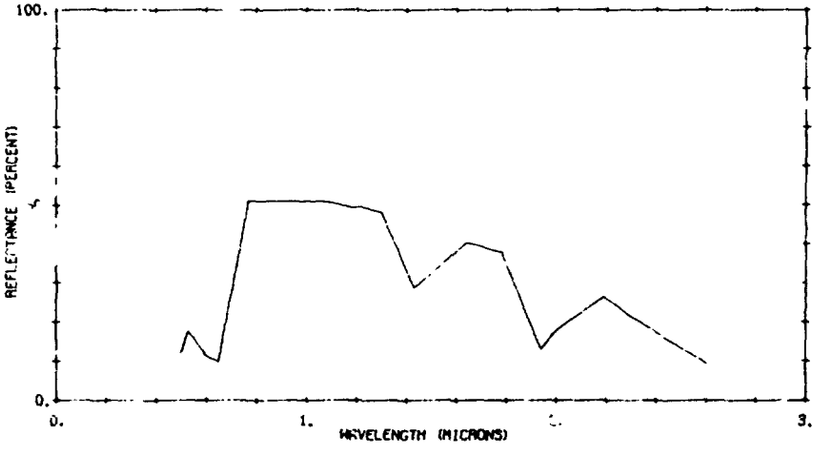
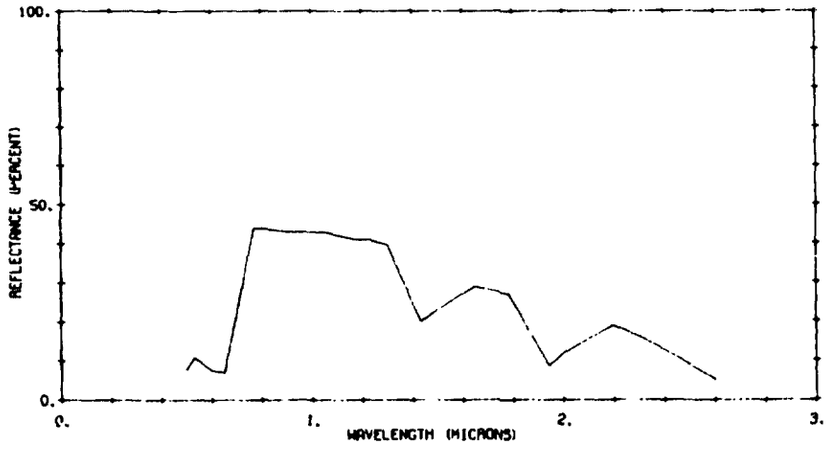


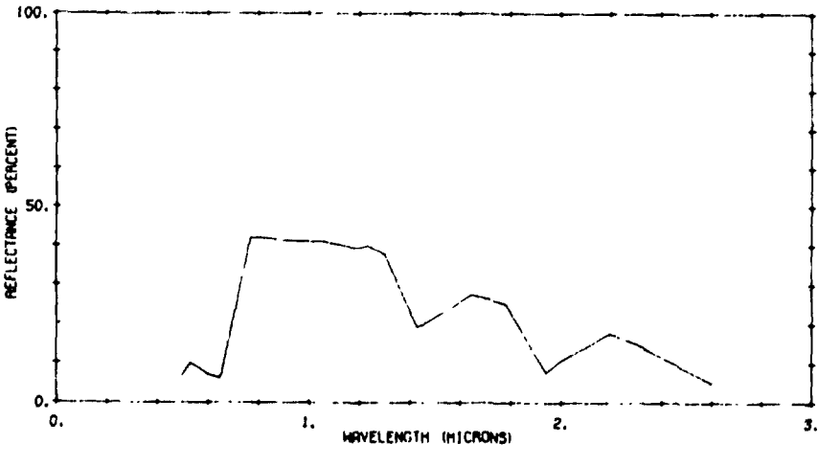
B09007 085

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY. JUVENILE LEAF



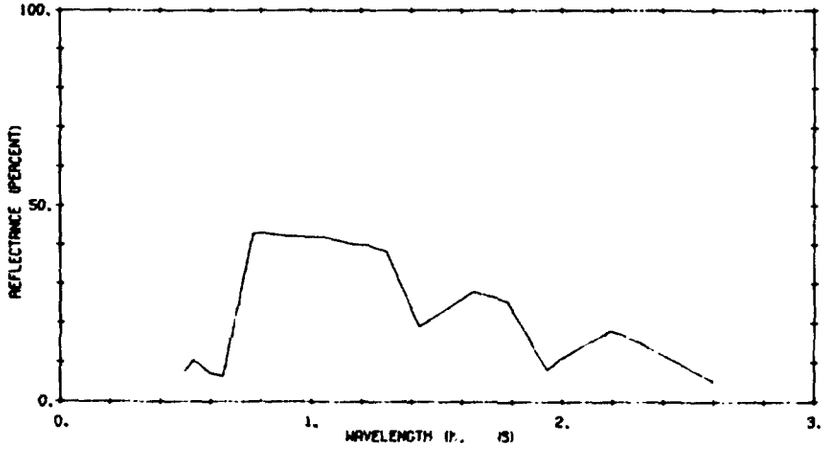
B09007 086

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY. JUVENILE LEAF.



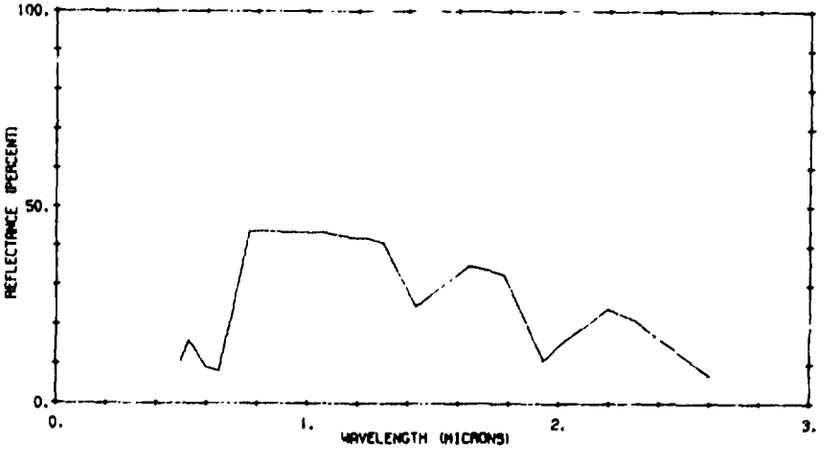
B09007 087

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY. JUVENILE LEAF.



B09007 088

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



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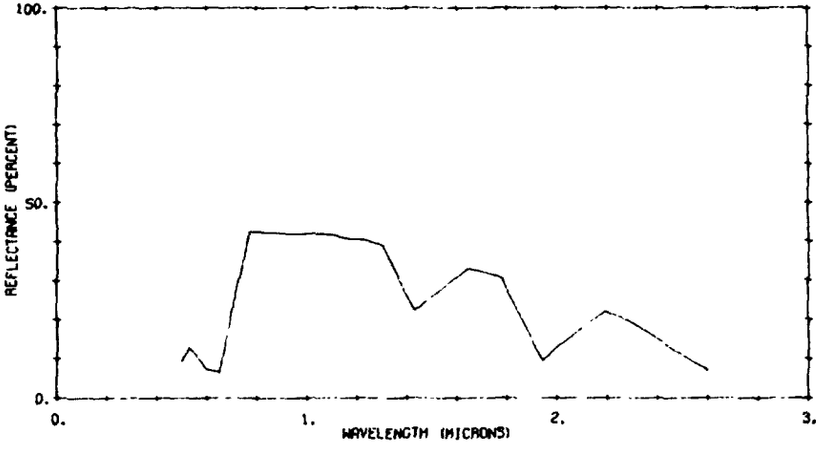

B09007 090

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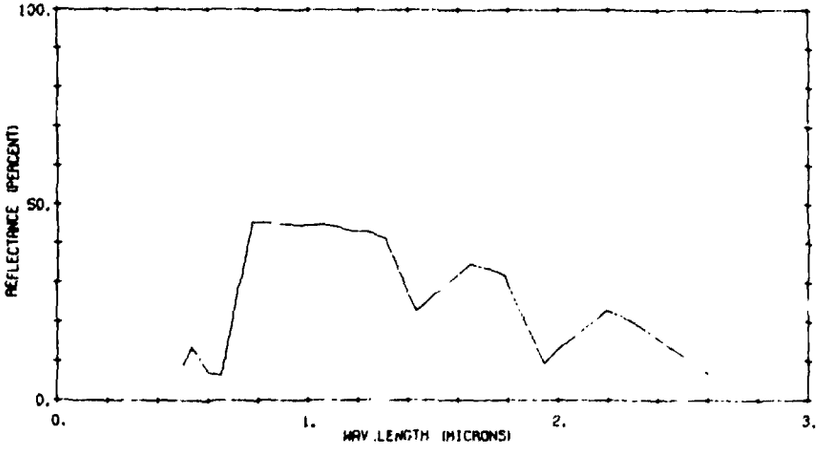
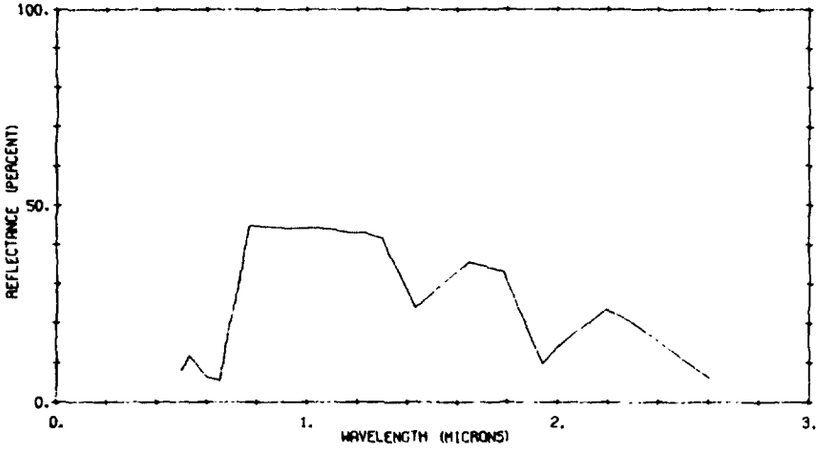


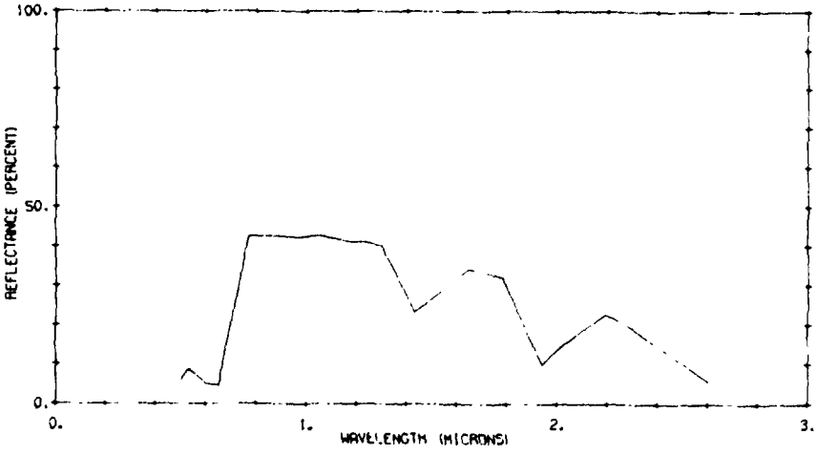
B09007 091

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



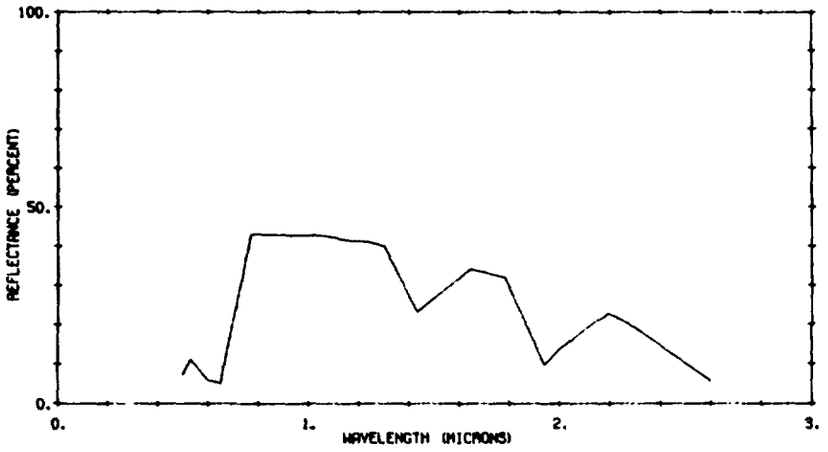
B09007 092

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



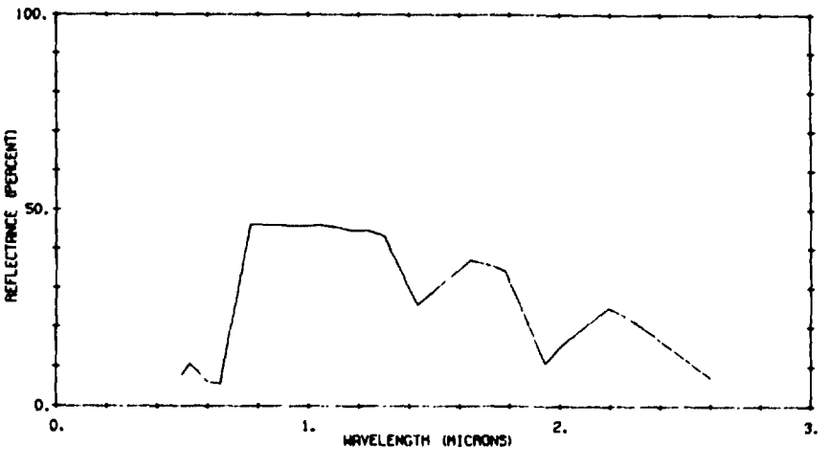
B09007 093

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



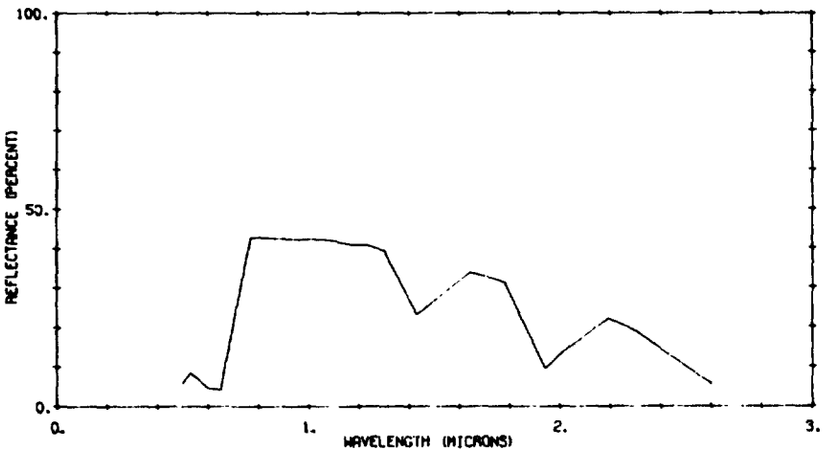
B09007 094

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



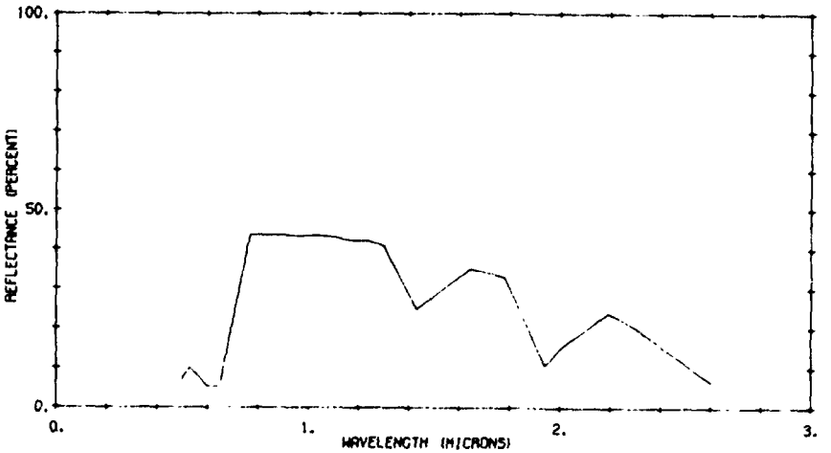
B09007 095

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



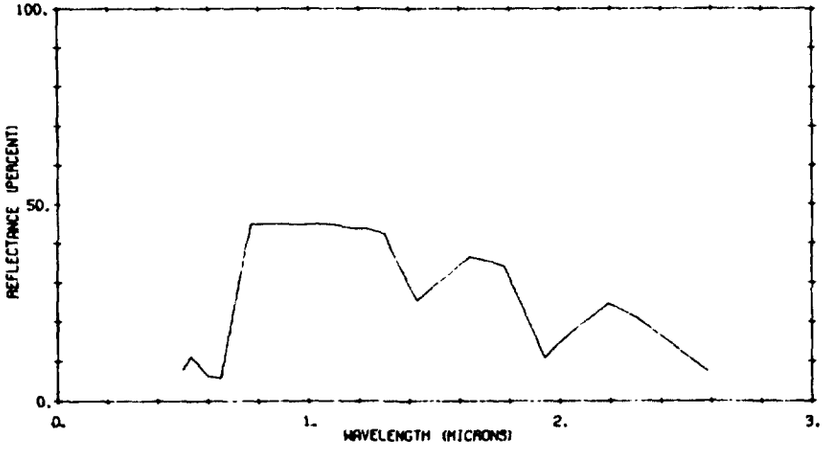
B09007 096

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



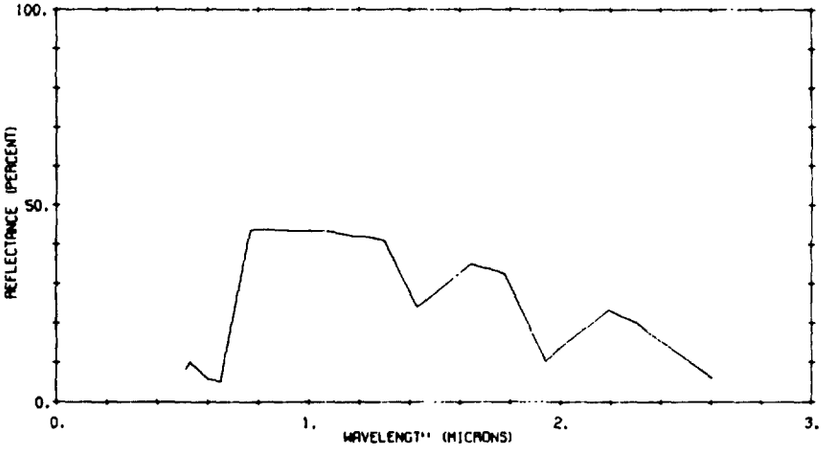
B09007 097

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



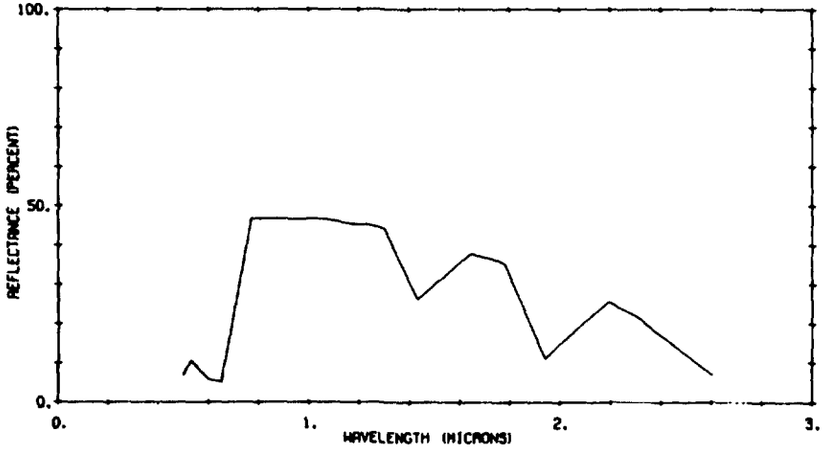
B09007 098

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



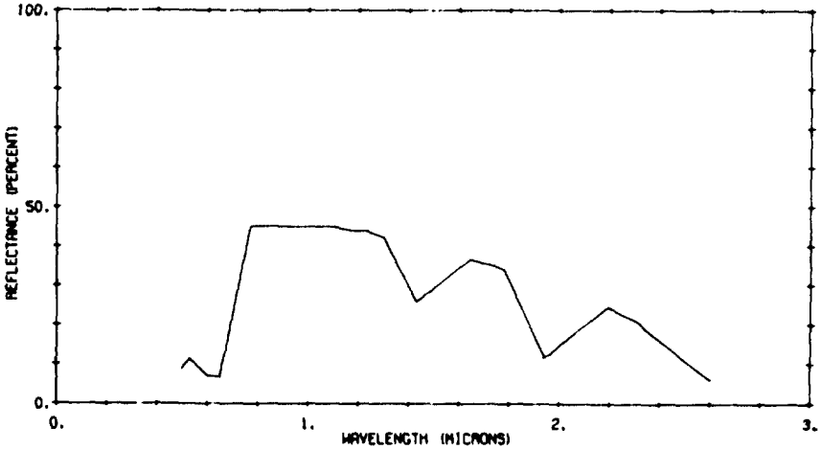
B09007 099

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



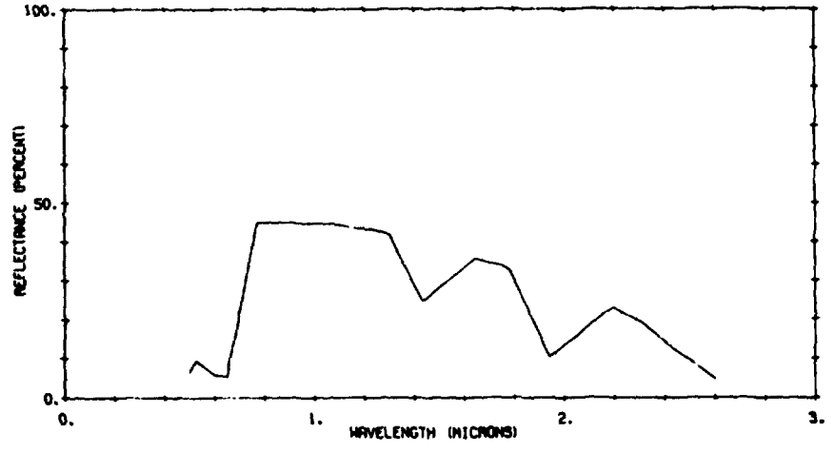
B09007 100

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY



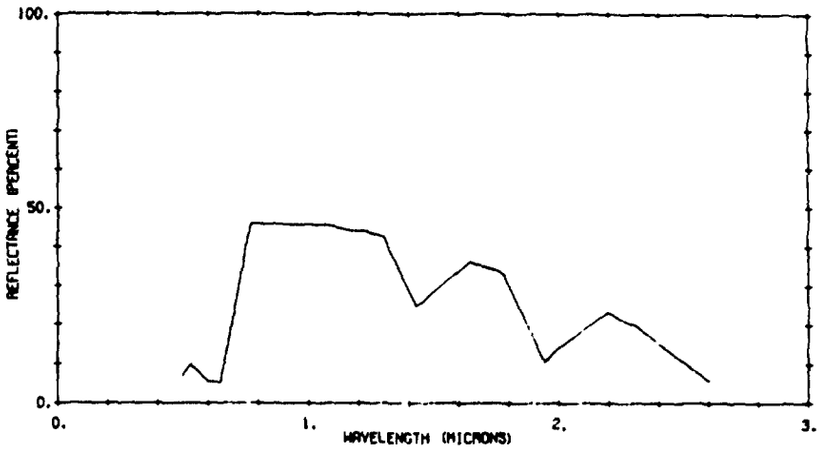
B09007 101

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



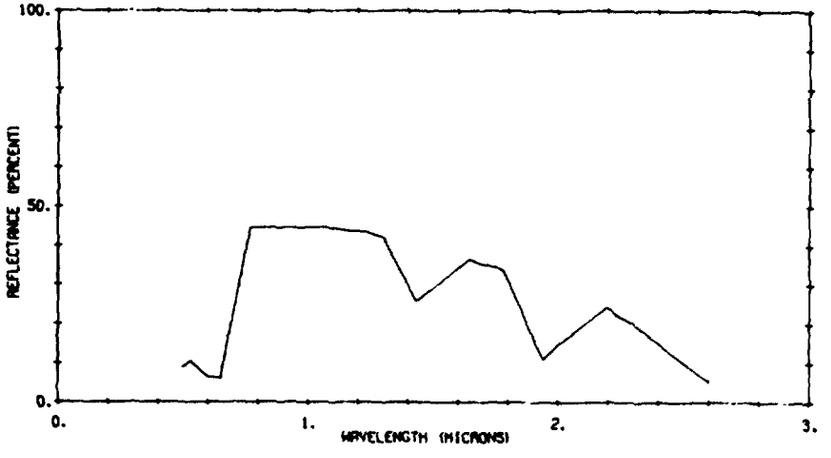
B09007 102

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



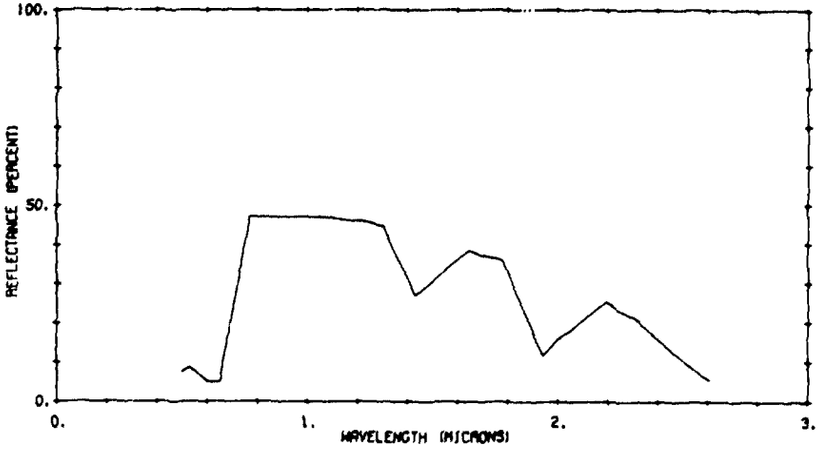
B09007 103

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



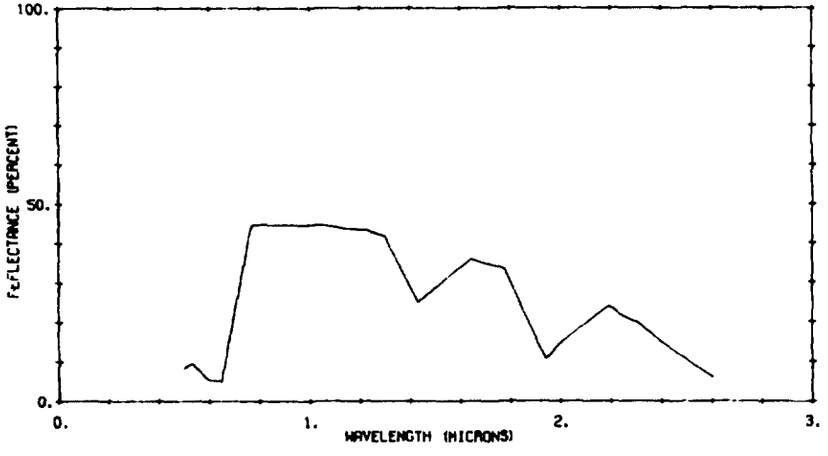
B09007 104

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



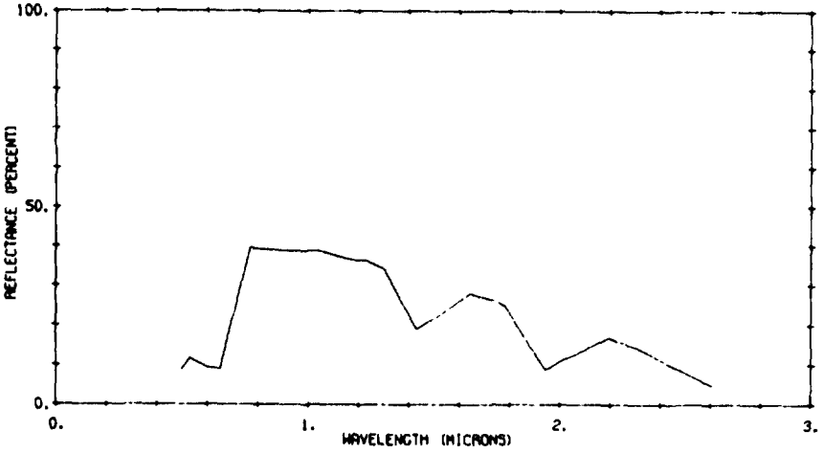
B09007 105

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



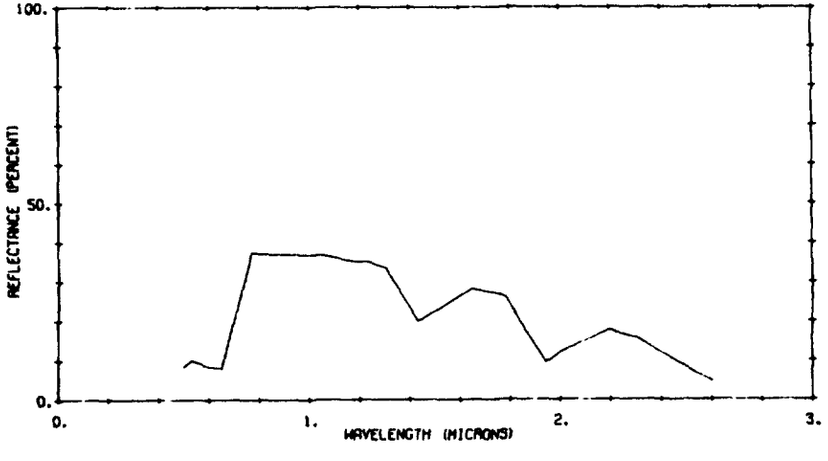
B09007 106

TREE 3, LEAF 4. LEAF FROM SECOND FLUSH OF SEASON.



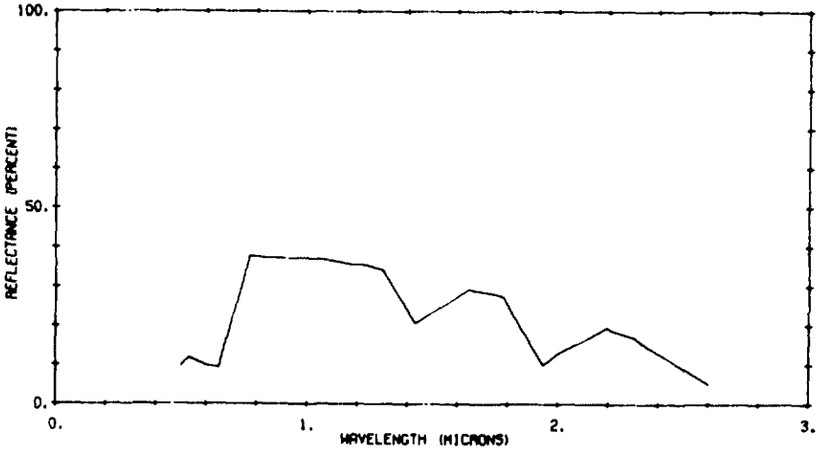
B09007 107

TREE 3, LEAF 5. LEAF FROM SECOND FLUSH OF SEASON



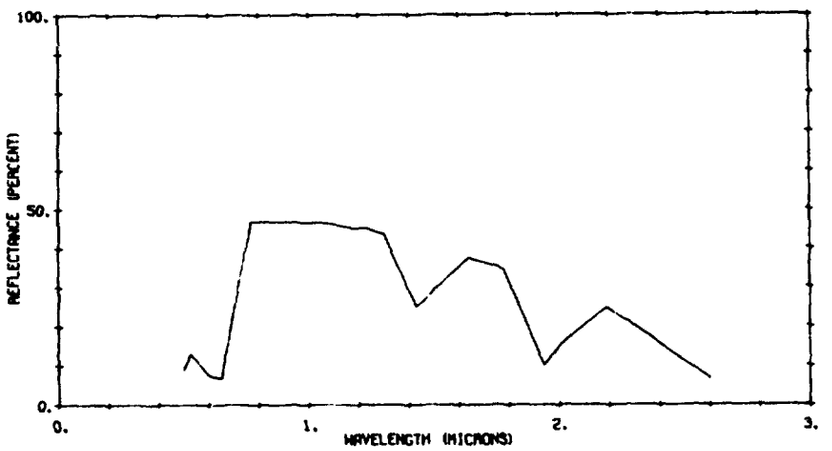
B09007 108

TREE 3, LEAF 8. LEAF FROM SECOND FLUSH OF SEASON.



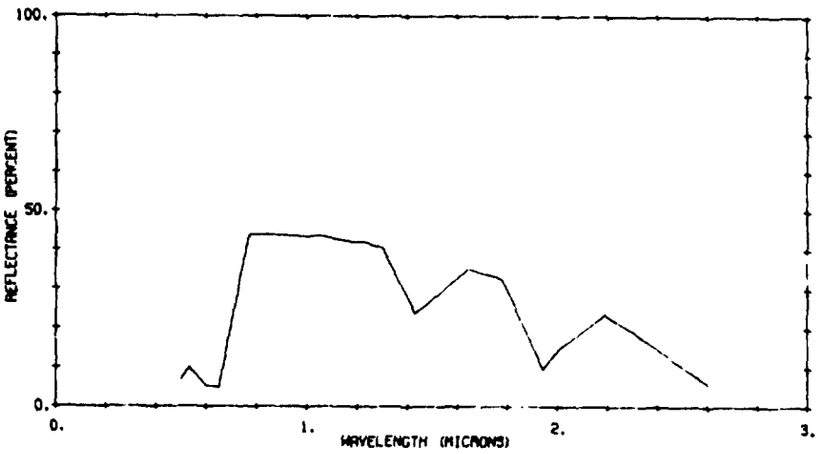
B09007 109

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



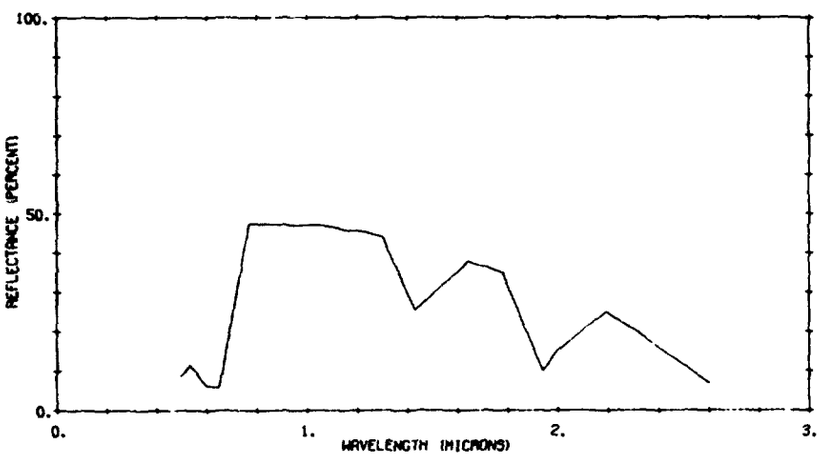
B09007 110

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



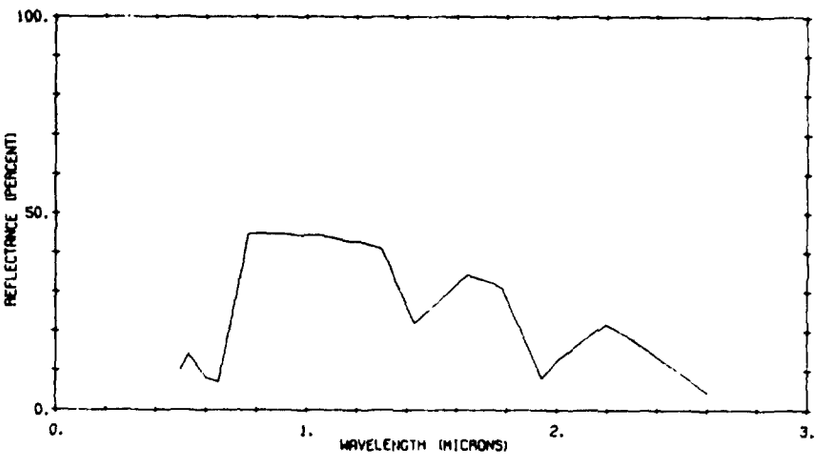
B09007 111

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



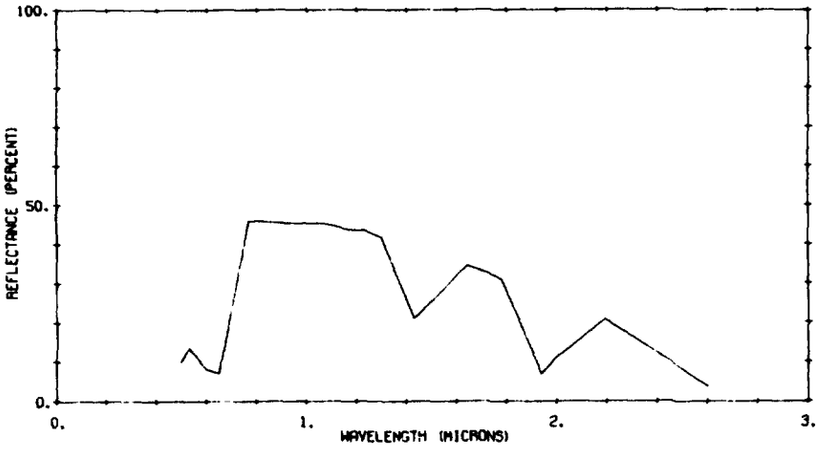
B09007 112

TREE 3, LEAF 4. LEAF FROM SECOND FLUSH OF SEASON.



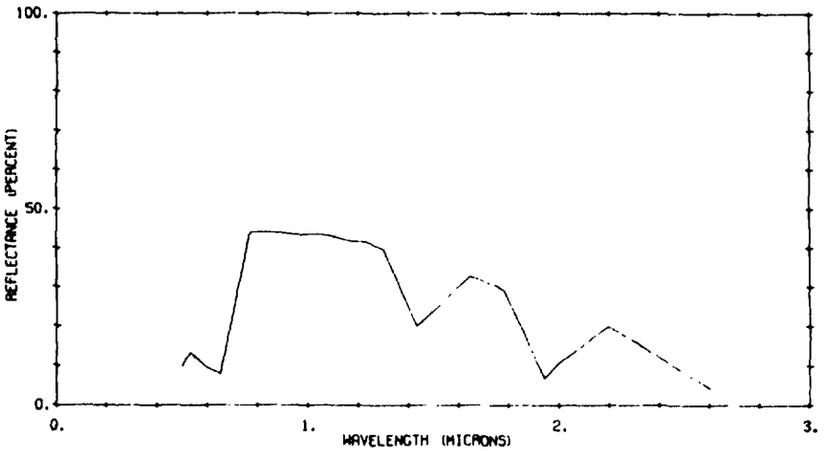
B09007 113

TREE 3, LEAF 5 WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



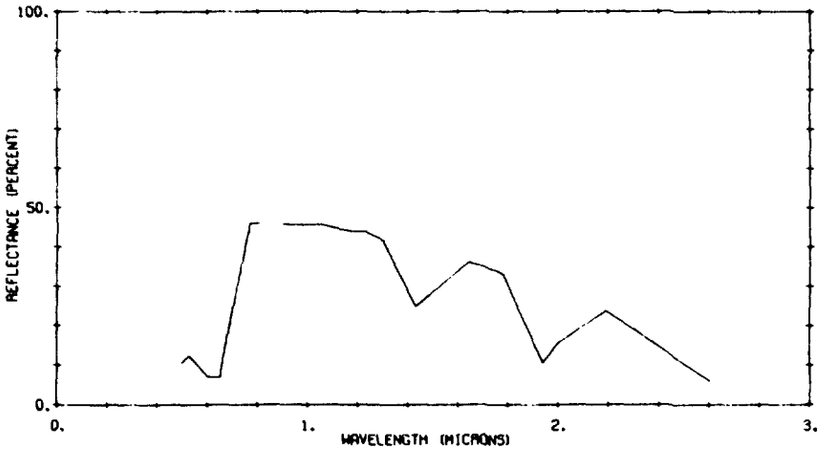
B09007 114

TREE 3, LEAF 6 WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



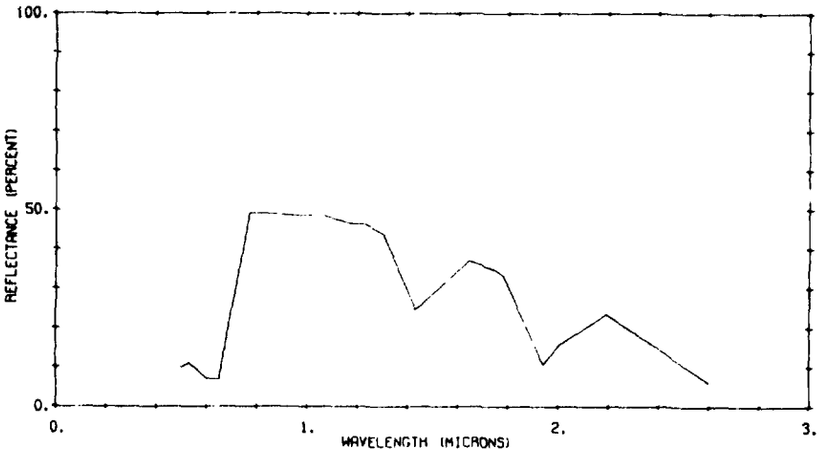
B09007 115

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



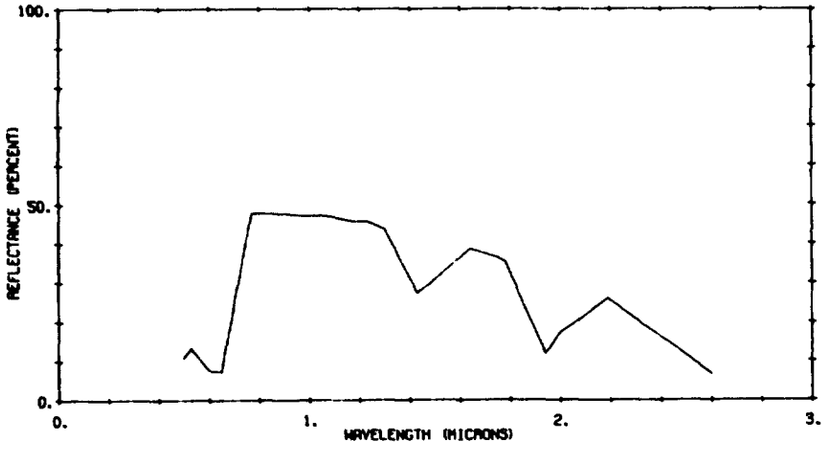
B09007 116

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



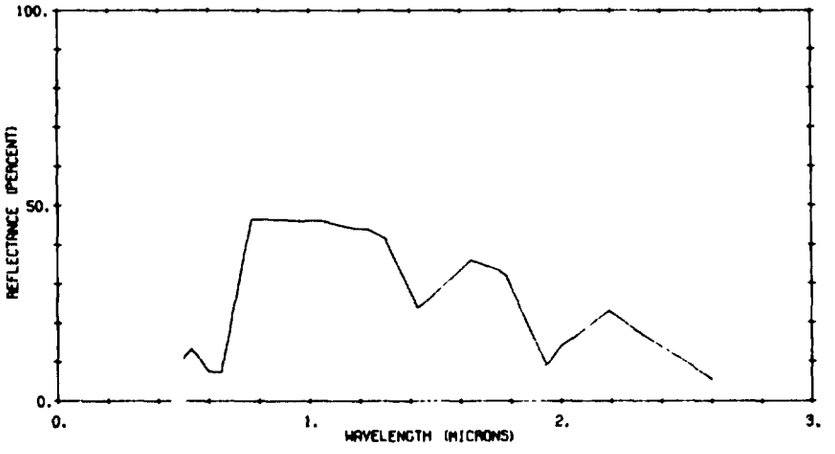
B09007 117

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



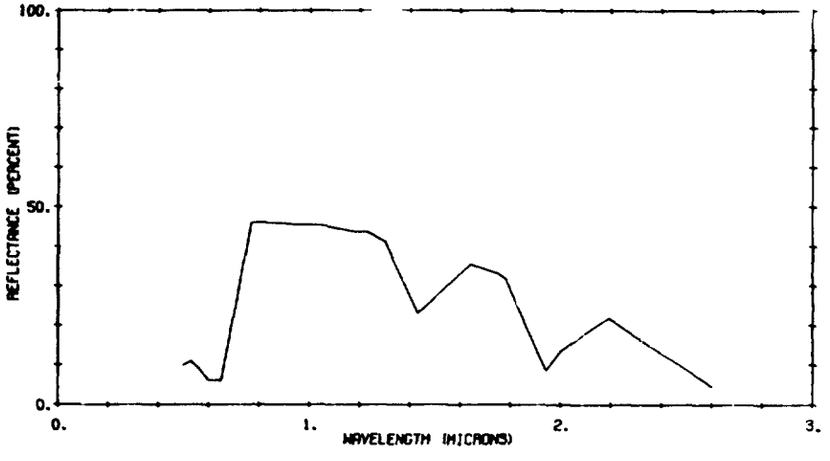
B09007 118

TREE 3, LEAF 4. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



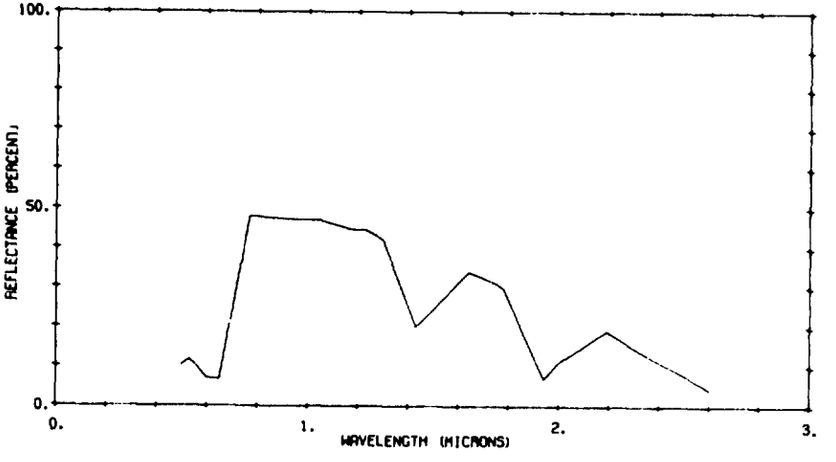
B09007 119

TREE 3, LEAF 5. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



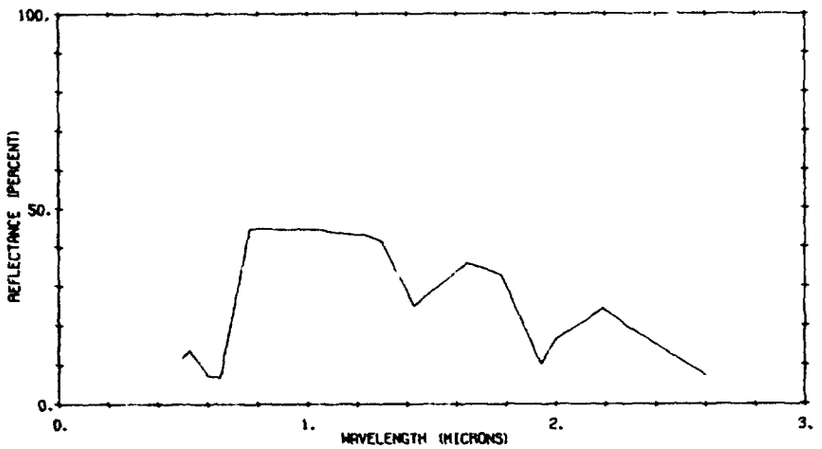
B09007 120

TREE 3, LEAF 6. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



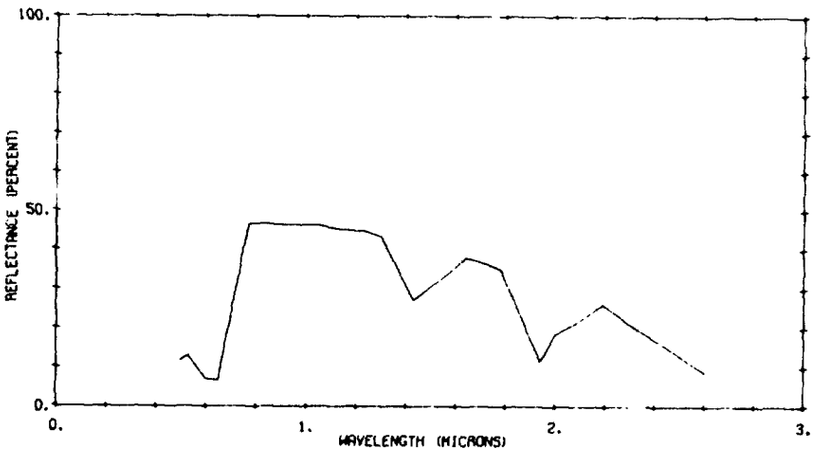
B09007 121

TREE 3, LEAF 1 WATERED EVERY SECOND OR THIRD DAY.



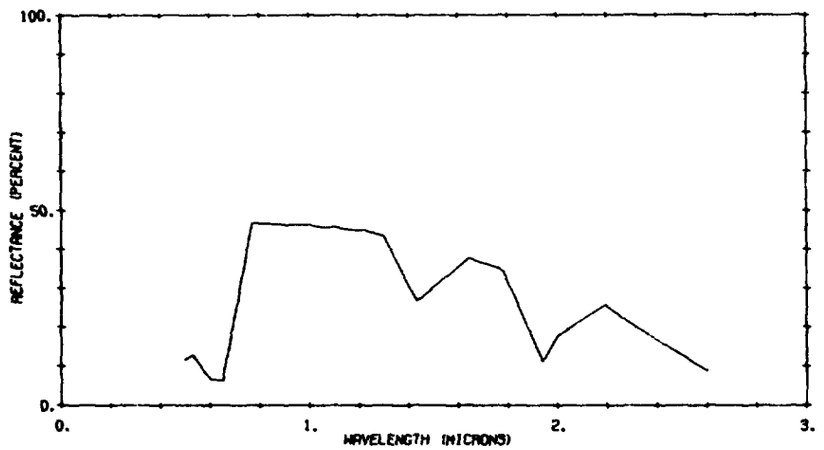
B09007 122

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



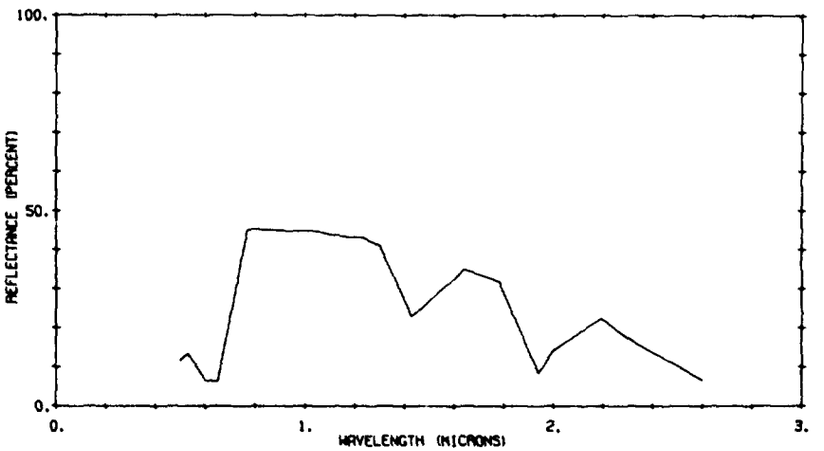
B09007 123

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



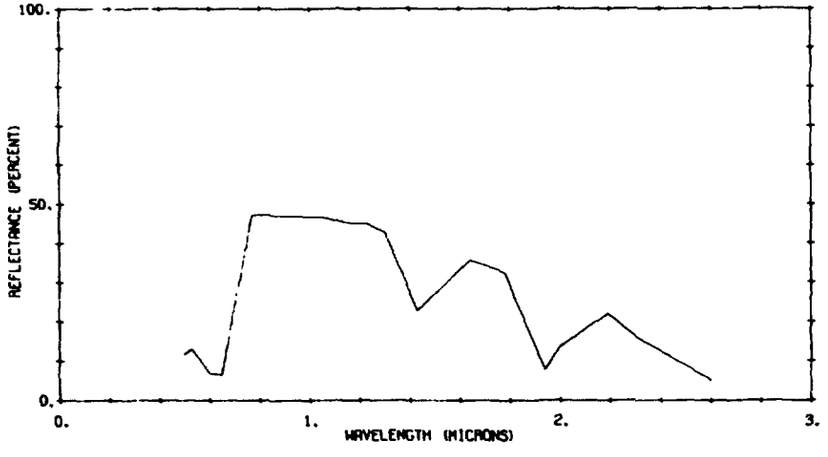
B09007 124

TREE 3, LEAF 4. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON



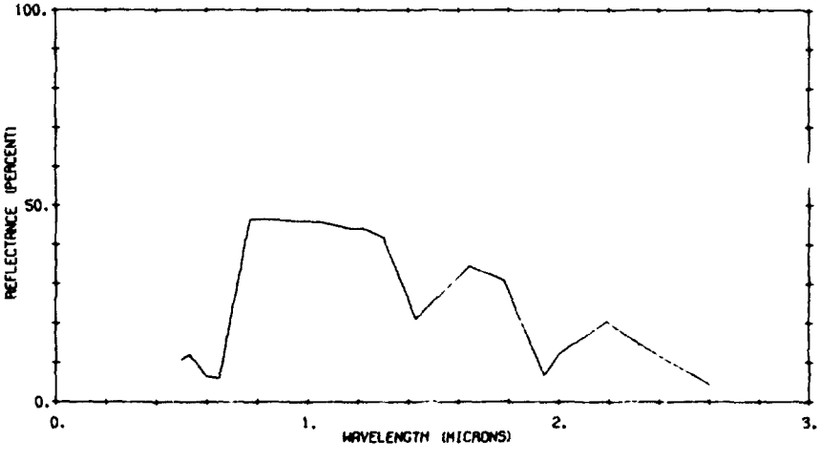
B09007 125

TREE 3, LEAF 5. WATERED EVERY SECOND OR THIRD DAY.



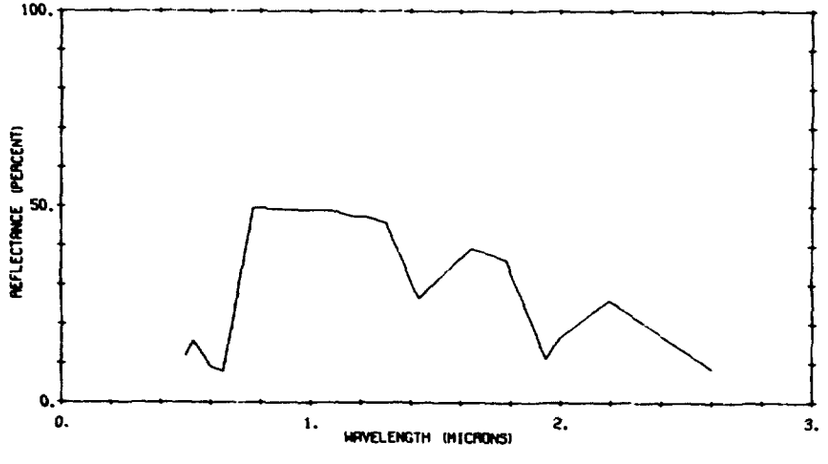
B09007 126

TREE 3, LEAF 6. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



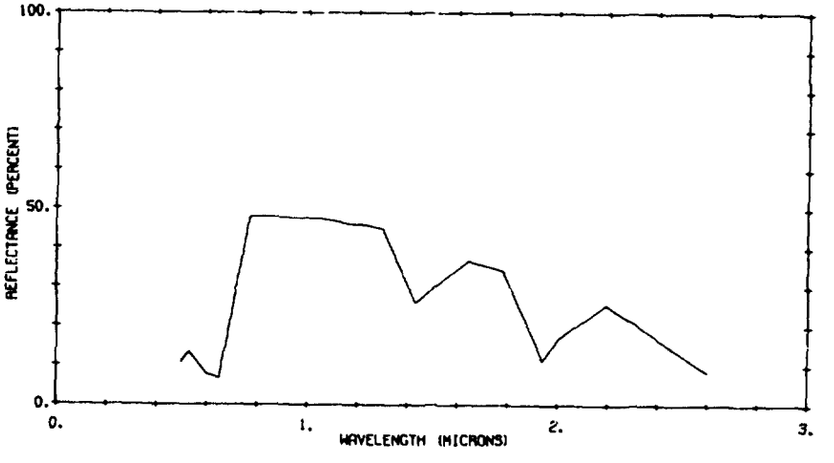
B09007 127

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



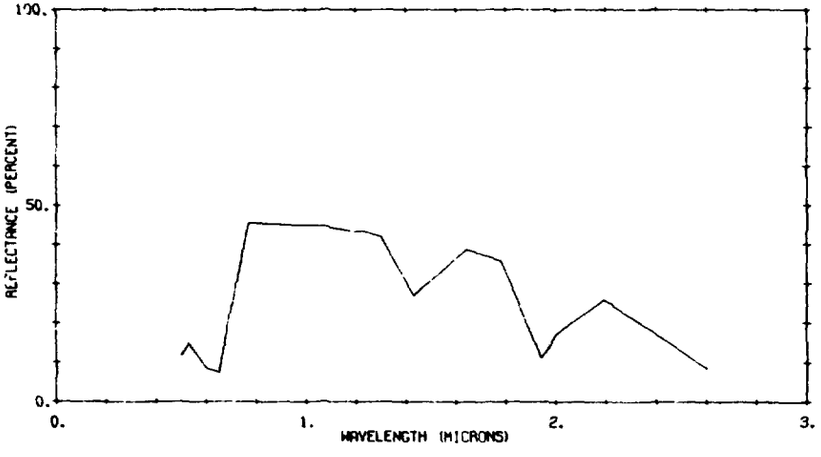
B09007 128

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



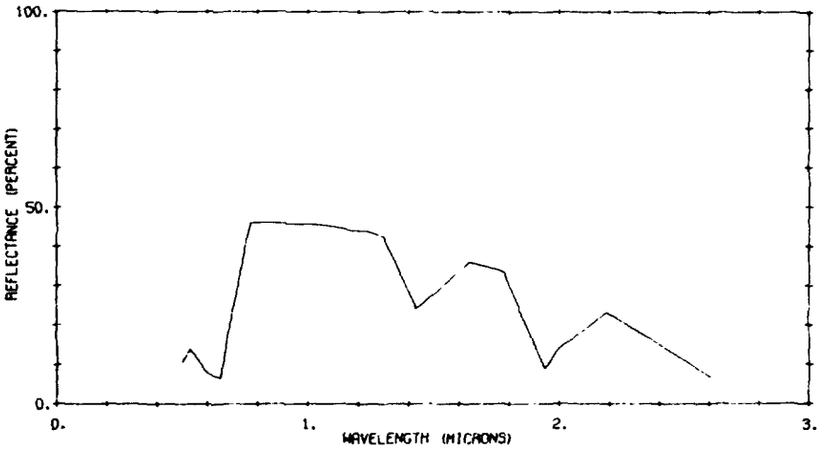
B09007 129

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



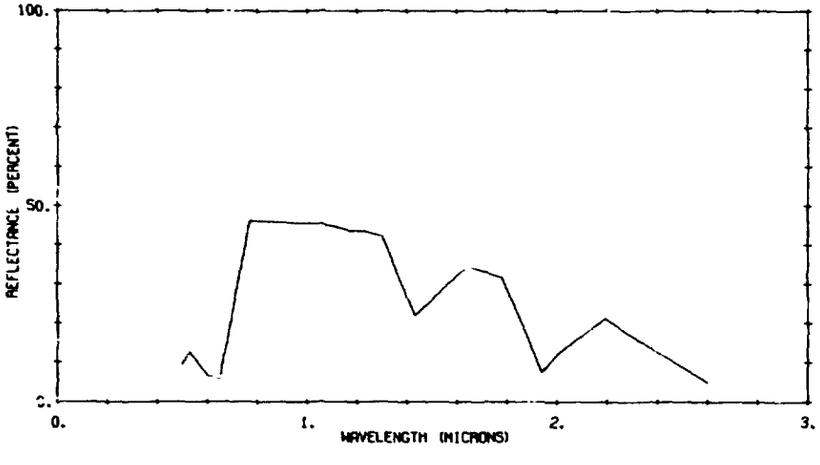
B09007 130

TREE 3, LEAF 4. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON



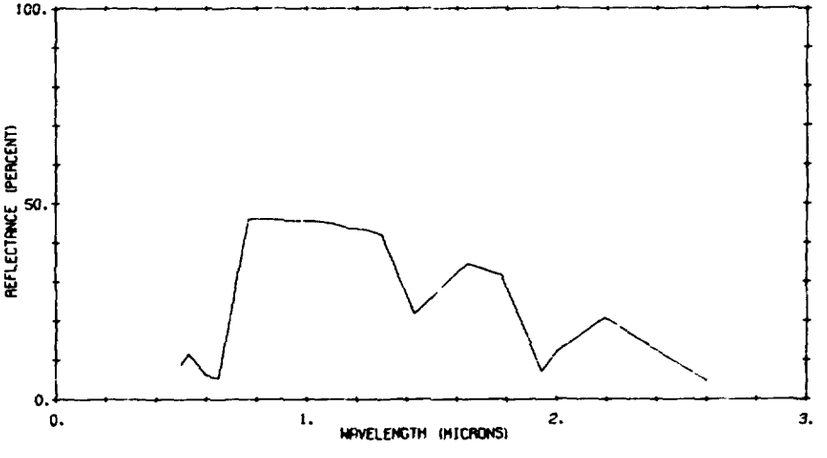
B09007 131

TREE 3, LEAF 5. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



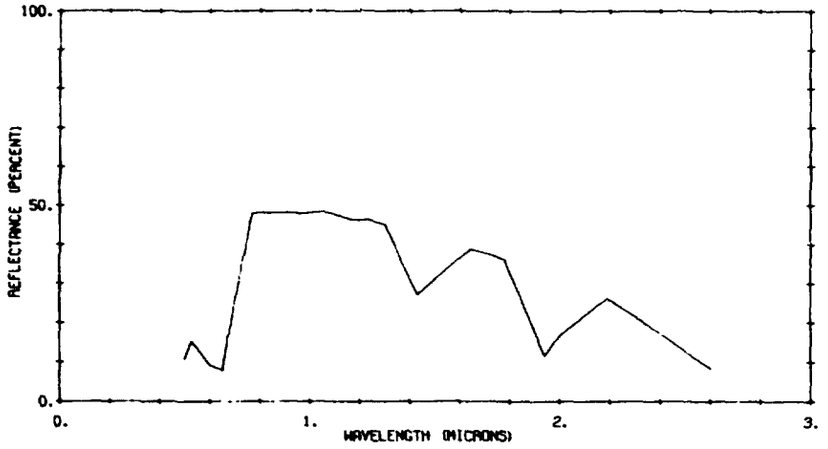
B09007 132

TREE 3, LEAF 6. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



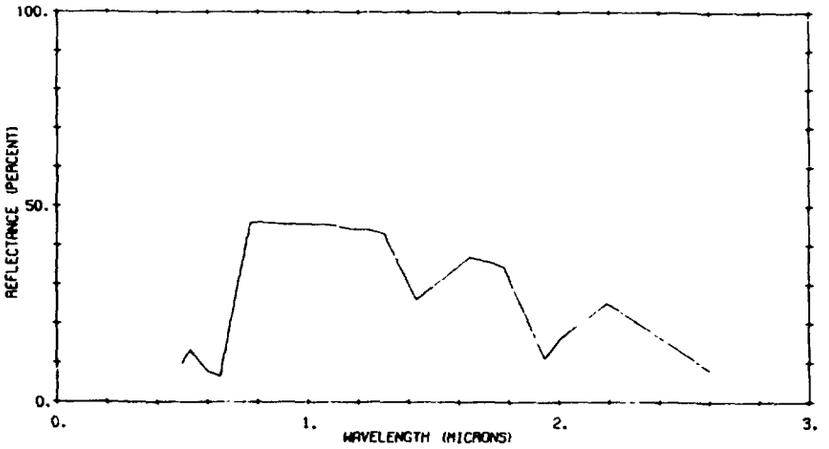
B09007 133

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



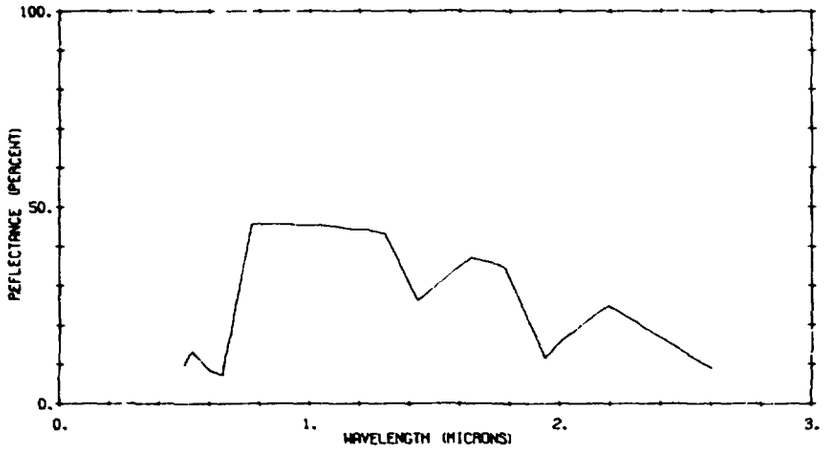
B09007 134

TREE 3, LEAF 2 WATERED EVERY SECOND OR THIRD DAY.



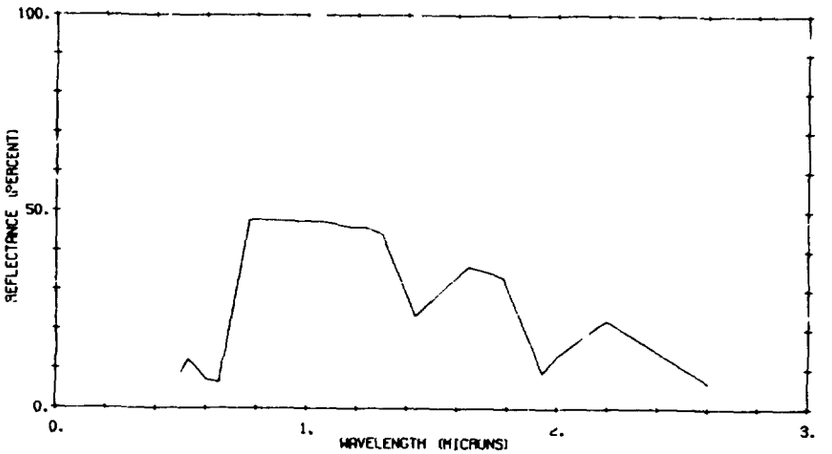
B09007 135

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



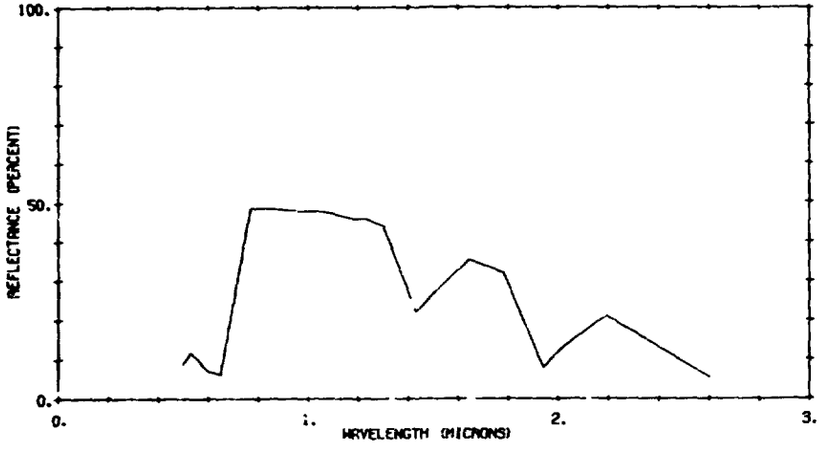
B09007 136

TREE 3, LEAF 4. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON



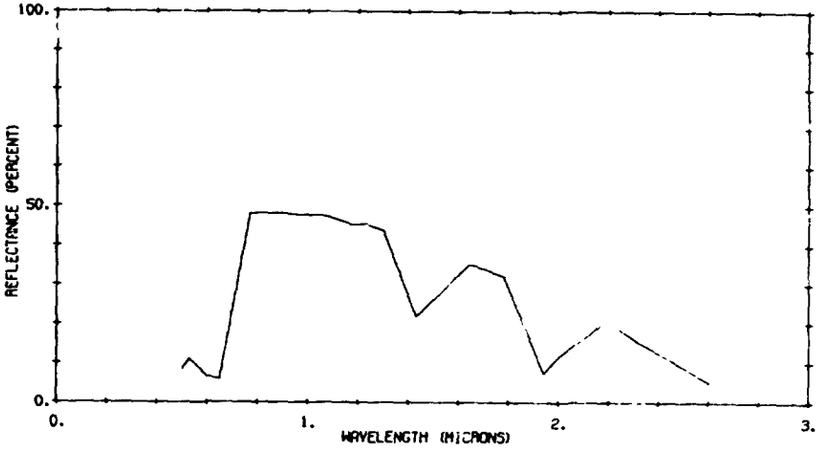
B09007 137

TREE 3, LEAF 5. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



B09007 138

TREE 3, LEAF 6. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON

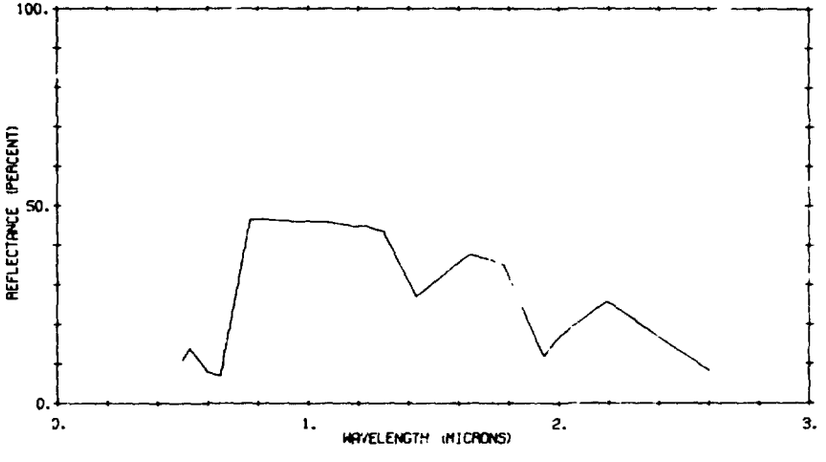


B09007 139

TREE 3, LEAF 4. WATERED EVERY SECOND OR THIRD DAY.

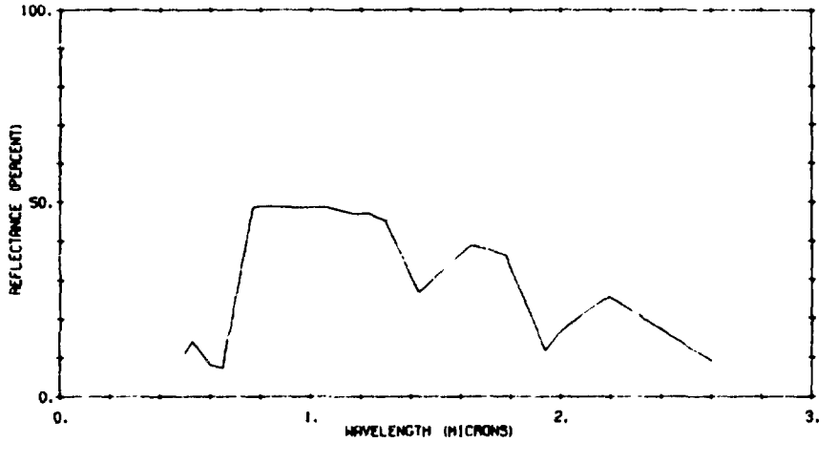
B09007 140

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



B09007 141

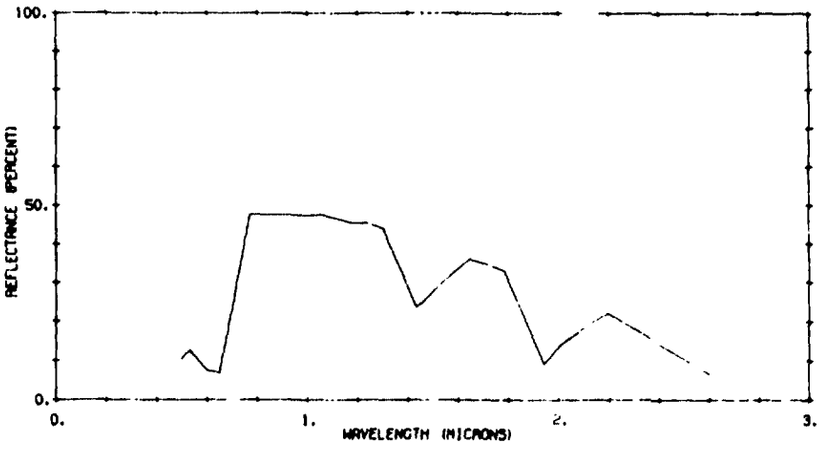
TREE 3, LEAF 3 WATERED EVERY SECOND OR THIRD DAY.



B09007 142

TREE 3, LEAF 4. WATERED EVERY SECOND OR THIRD DAY

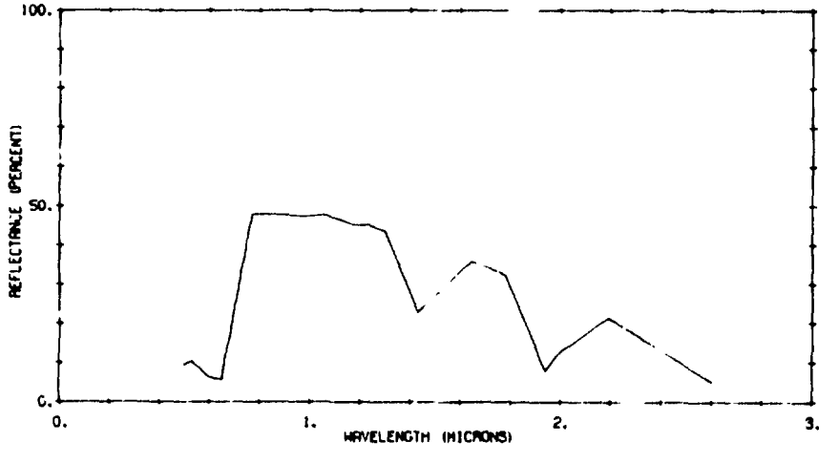
LEAF FROM SECOND FLUSH OF SEASON



B09007 143

TREE 3, LEAF 5. WATERED EVERY SECOND OR THIRD DAY.

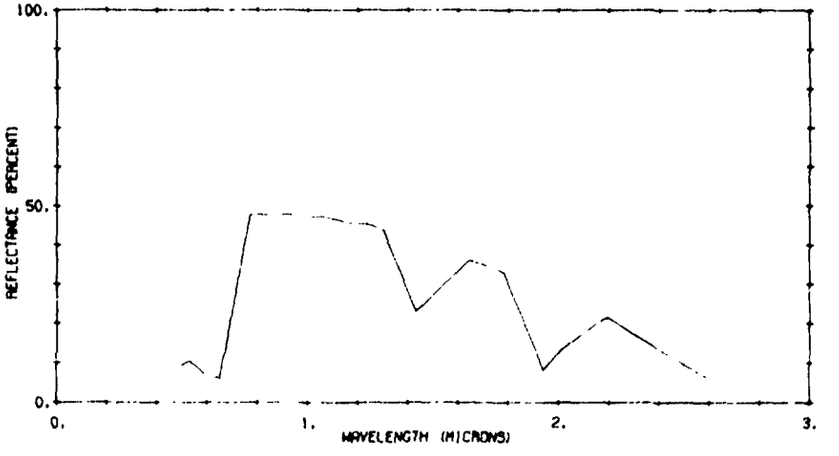
LEAF FROM SECOND FLUSH OF SEASON



B09007 144

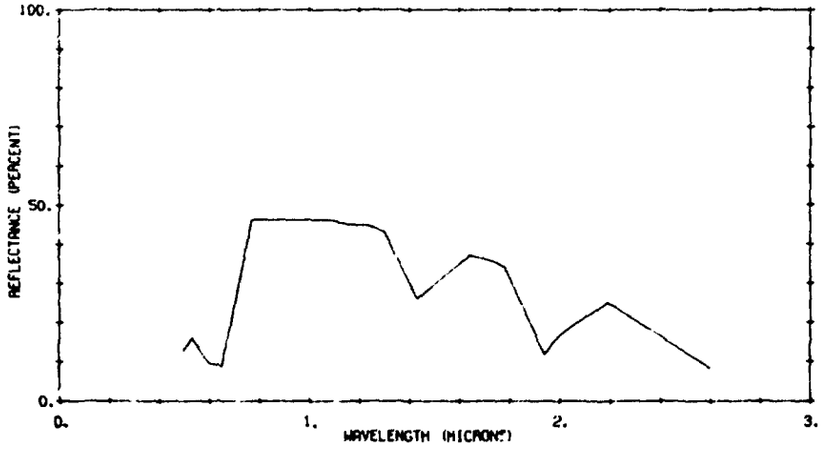
TREE 3, LEAF 6. WATERED EVERY SECOND OR THIRD DAY.

LEAF FROM SECOND FLUSH OF SEASON



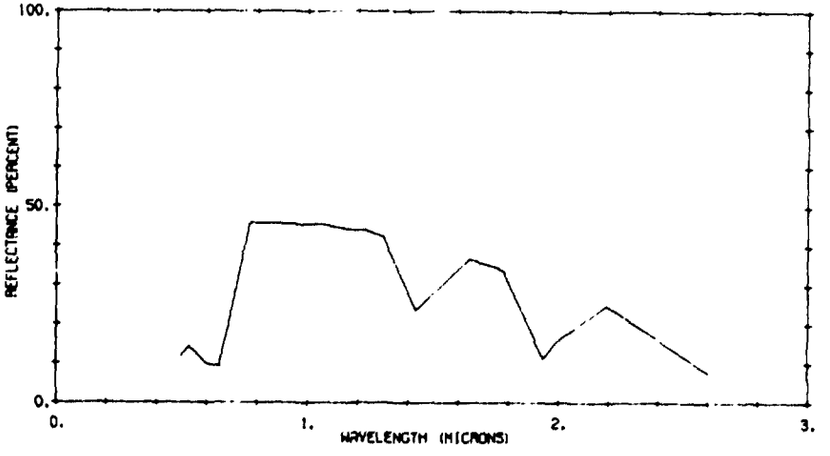
B09007 145

TREE 3, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



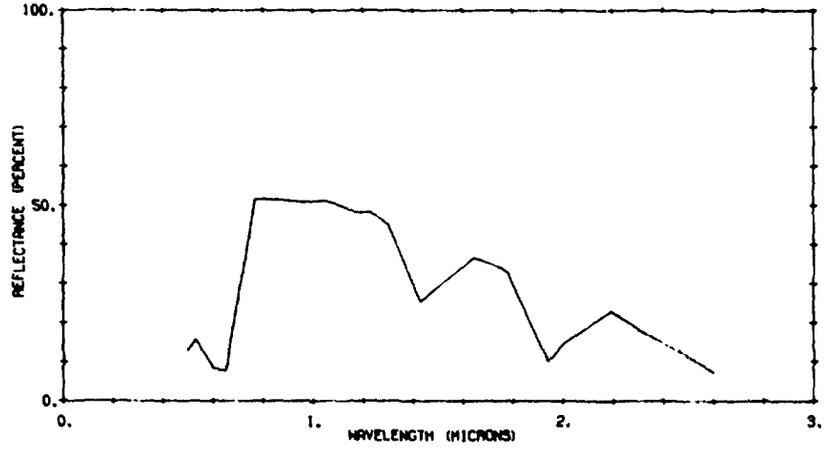
B09007 146

TREE 3, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



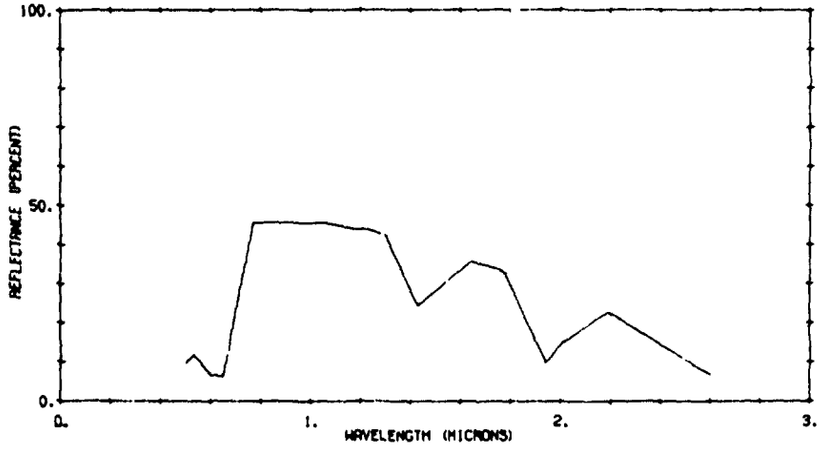
B09007 147

TREE 3, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



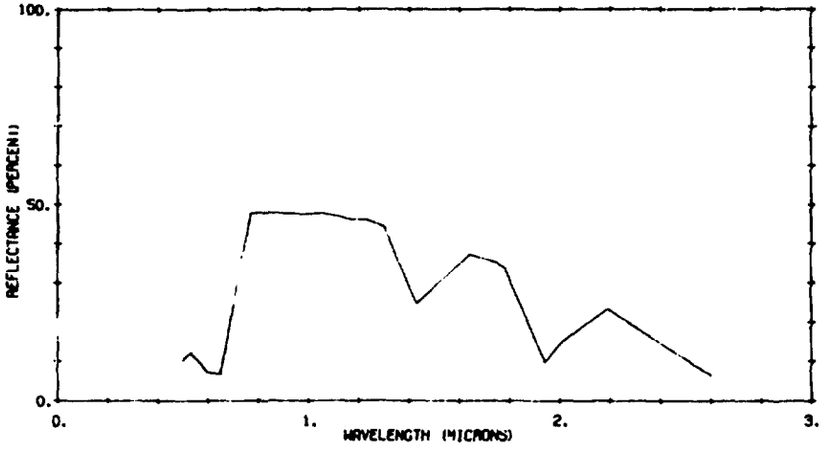
B09007 148

TREE 3, LEAF 4. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON



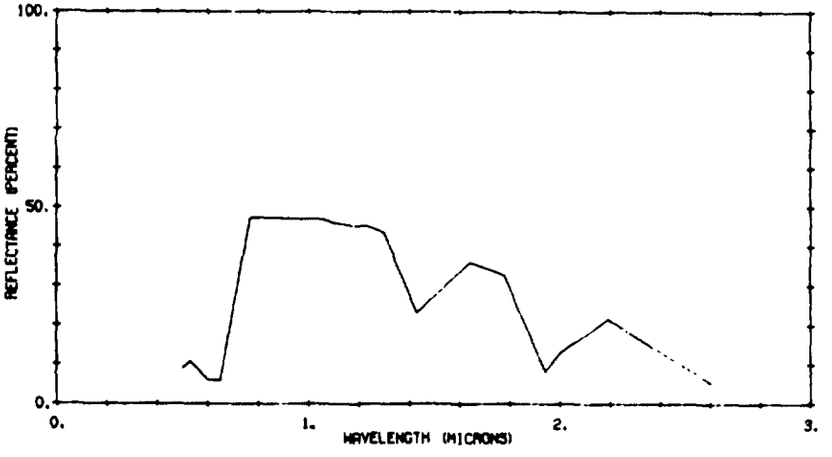
809007 149

TREE 3, LEAF 5. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON



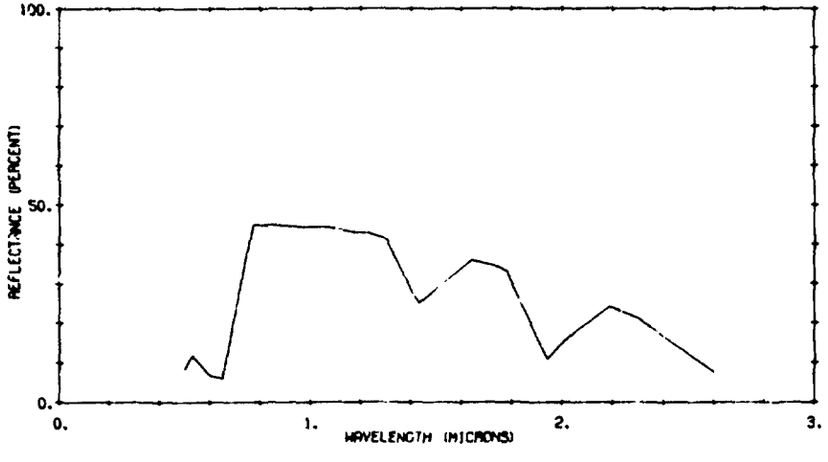
809007 150

TREE 3, LEAF 6. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON



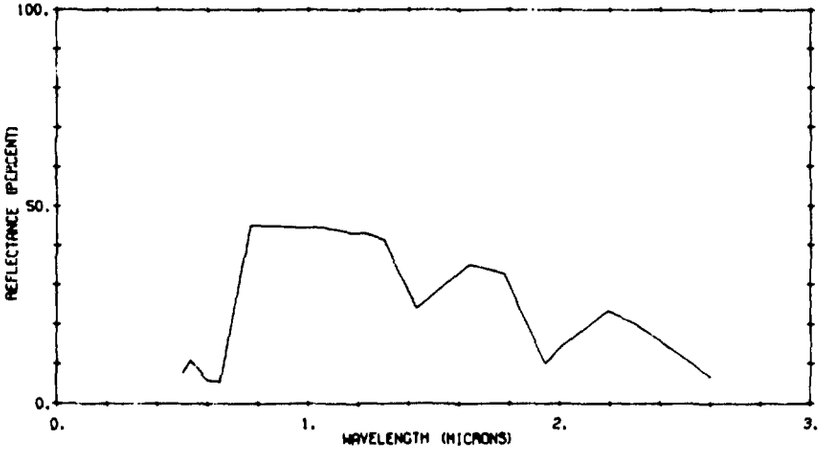
809007 151

TREE 4, LEAF 1 WATERED EVERY SECOND OR THIRD DAY.



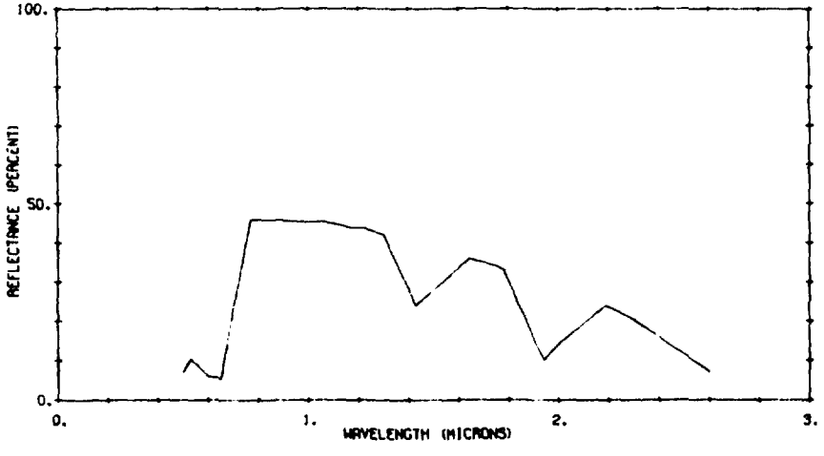
809007 152

TREE 4, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



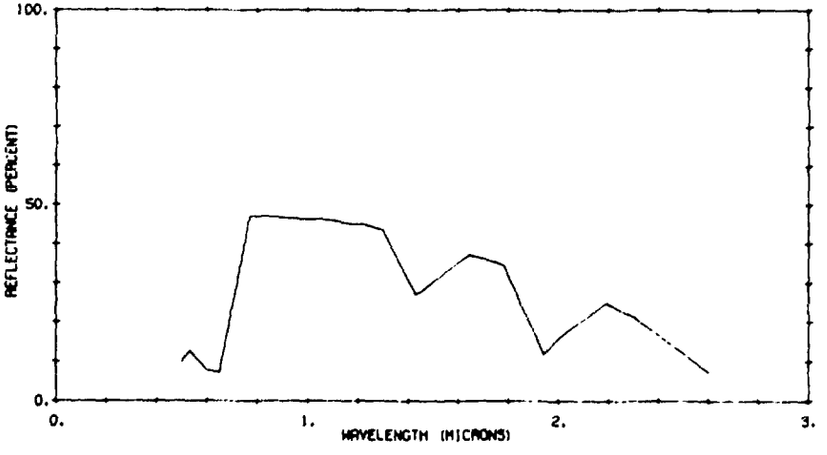
809007 153

TREE 4, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



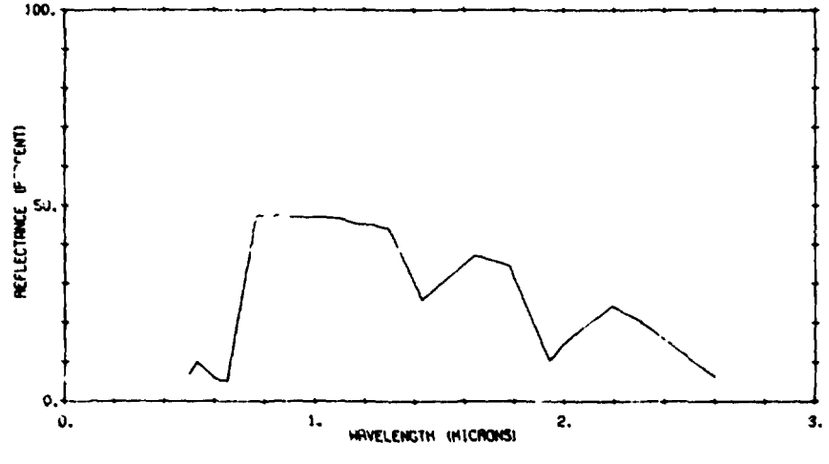
809007 154

TREE 4, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



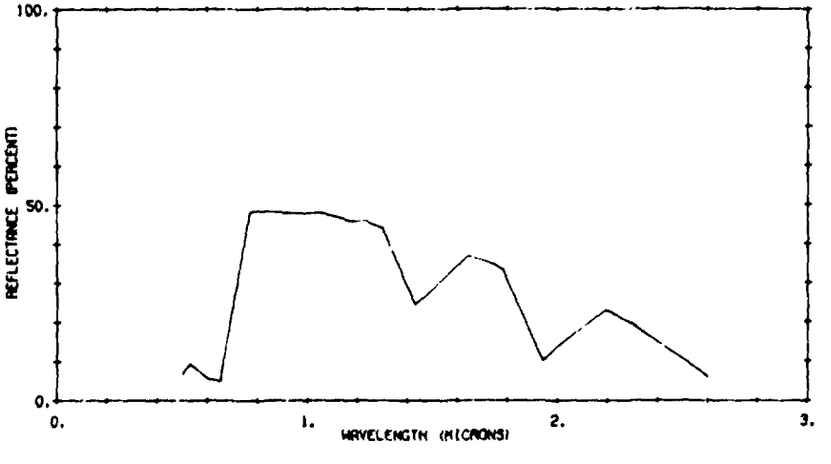
809007 155

TREE 4, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



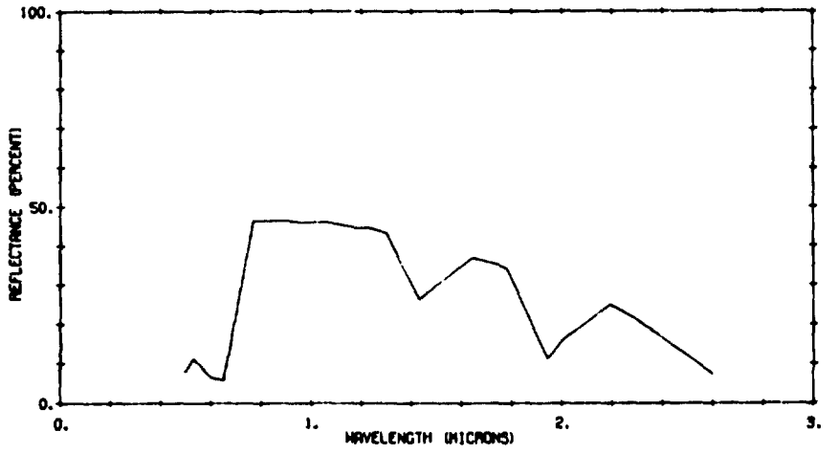
809007 156

TREE 4, LEAF 3 WATERED EVERY SECOND OR THIRD DAY



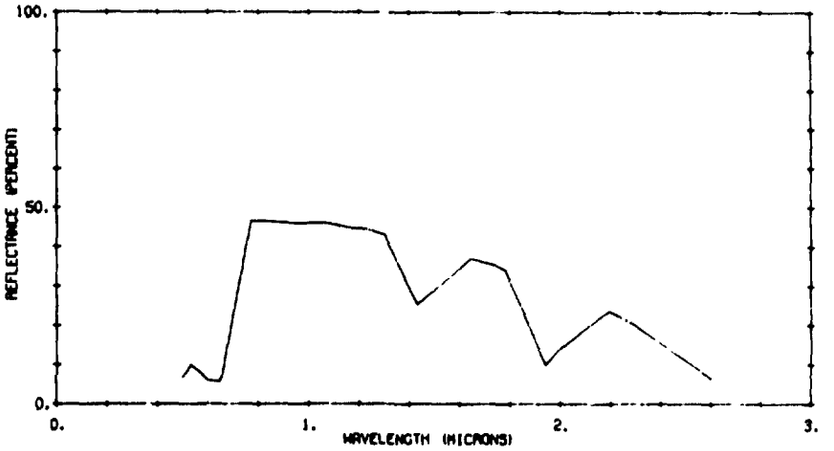
B09007 157

TREE 4, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



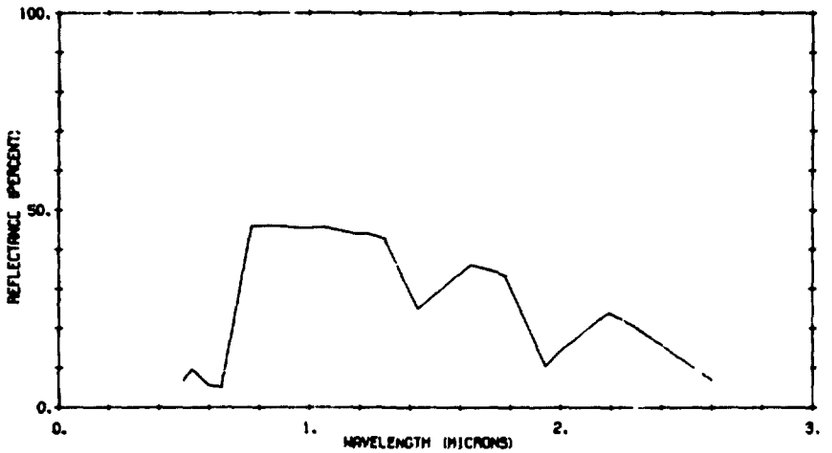
B09007 158

TREE 4, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



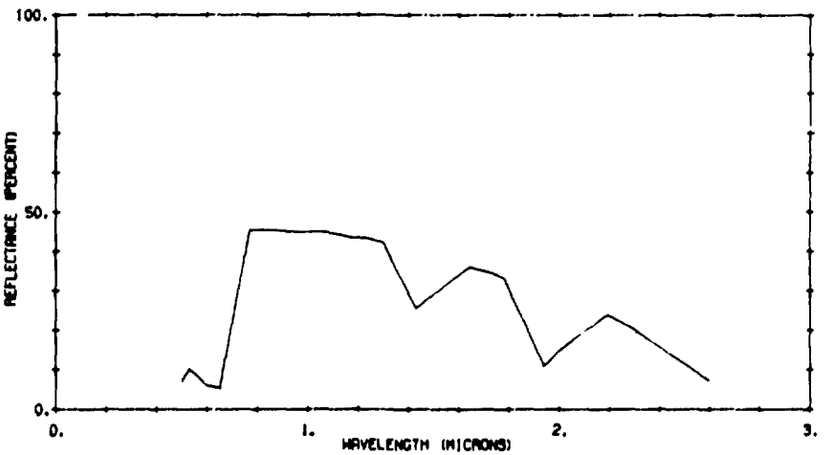
B09007 159

TREE 4, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



B09007 160

TREE 4, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.

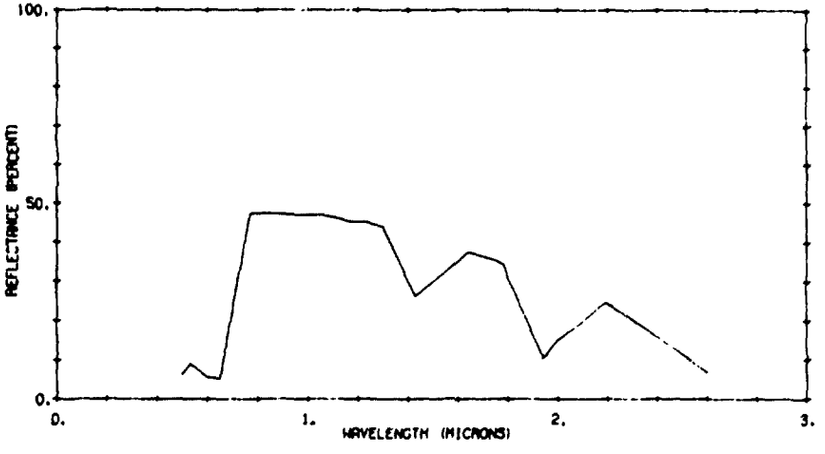


B09007 161

TREE 4, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.

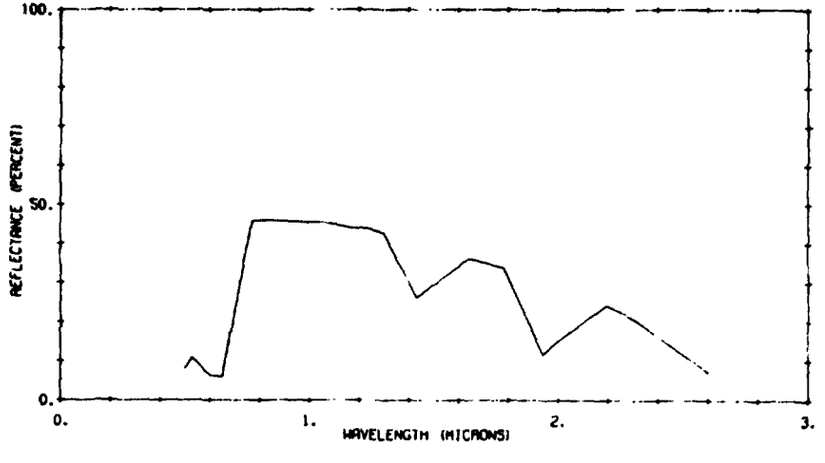
B09007 162

TREE 4, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



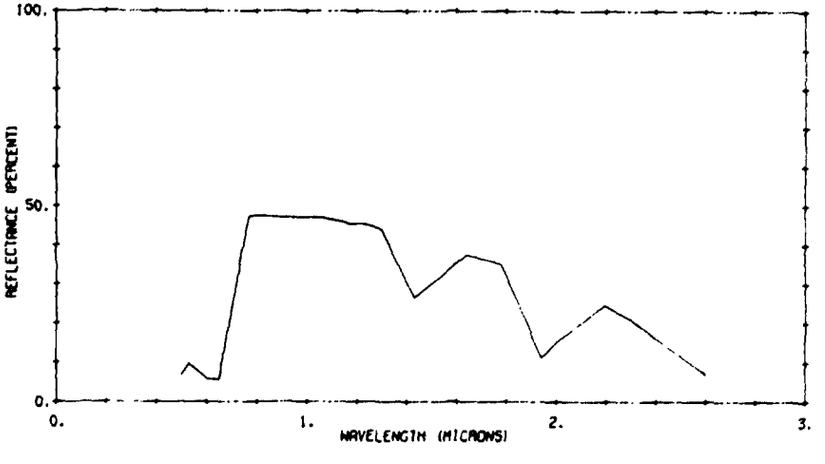
B09007 163

TREE 4, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



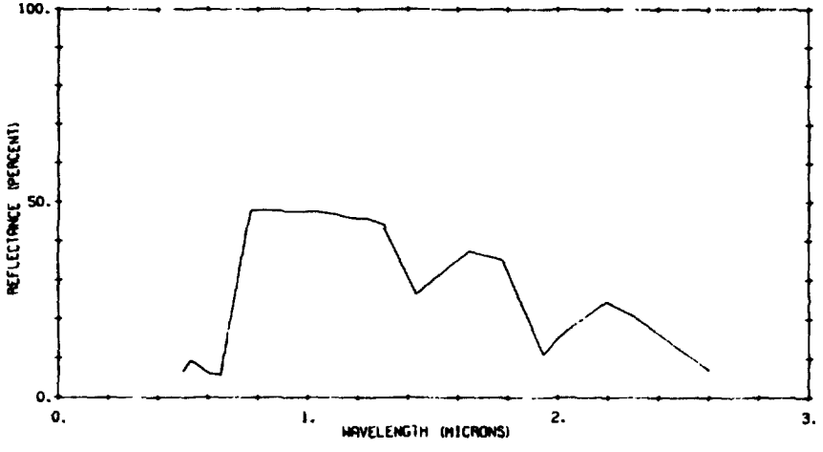
B09007 164

TREE 4, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



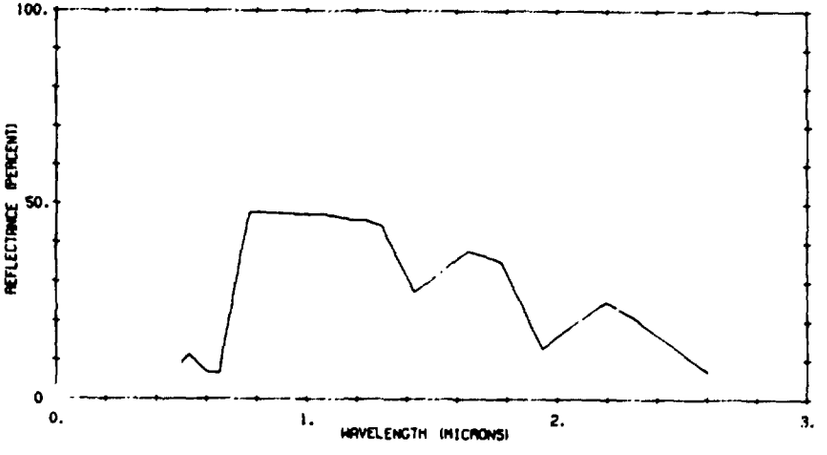
809007 165

TREE 4, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



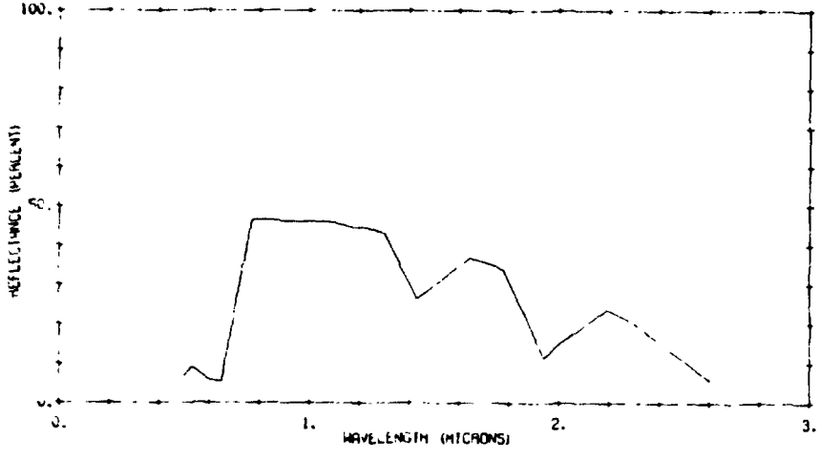
809007 166

TREE 4, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



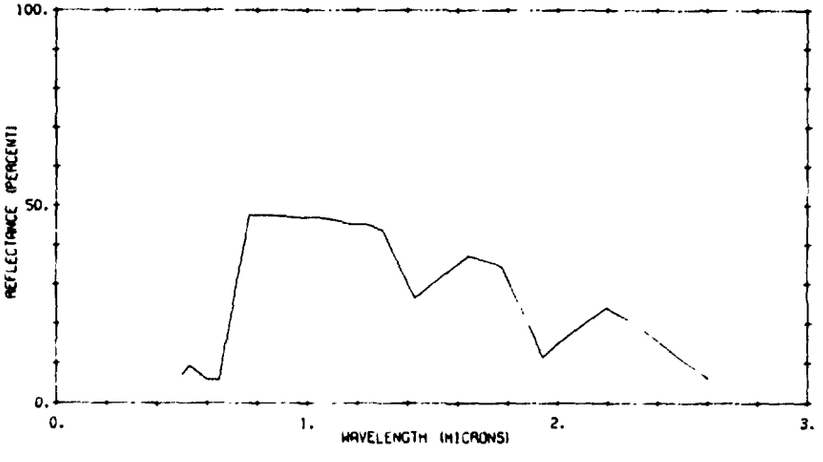
809007 167

TREE 4, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



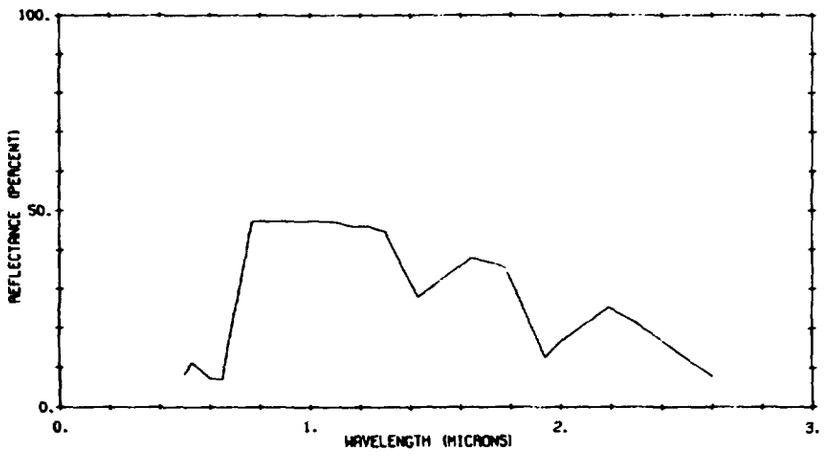
809007 168

TREE 4, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



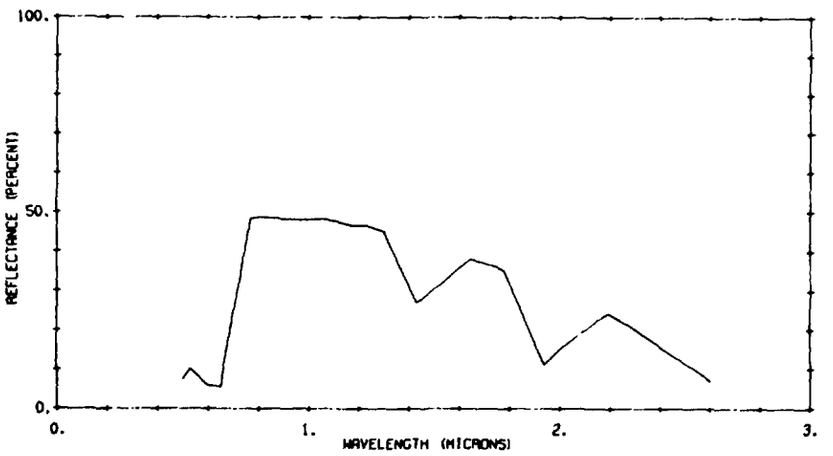
B09007 169

TREE 4, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



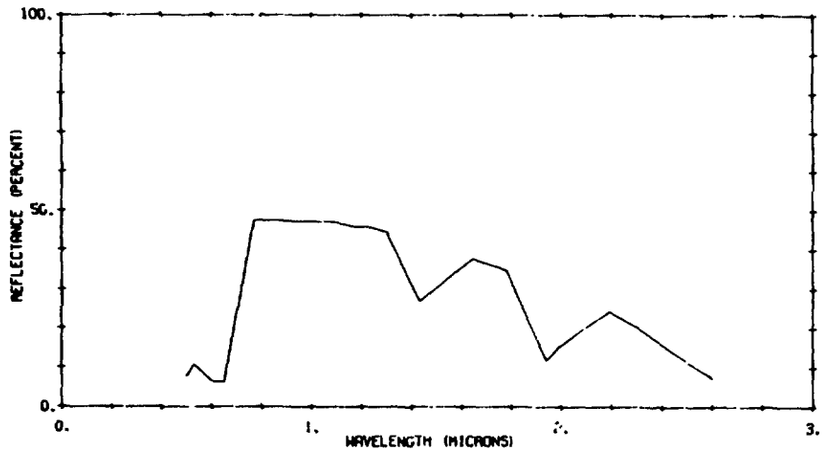
B09007 170

TREE 4 LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



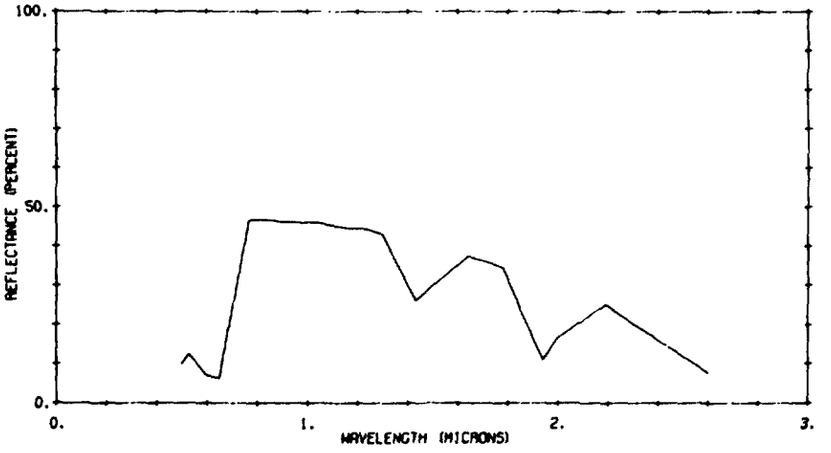
B09007 171

TREE 4, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



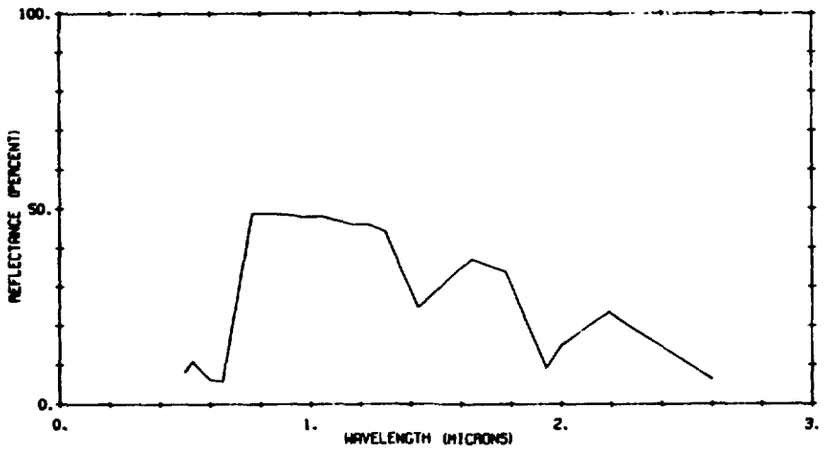
B09007 172

TREF 4, LEAF 1. NO WATER SINCE 18 JUNE



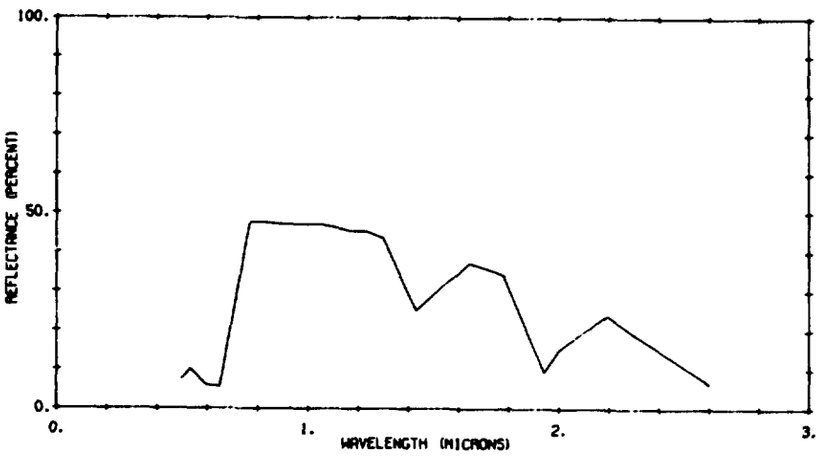
B09007 173

TREE 4, LEAF 2. NO WATER SINCE 18 JUNE.



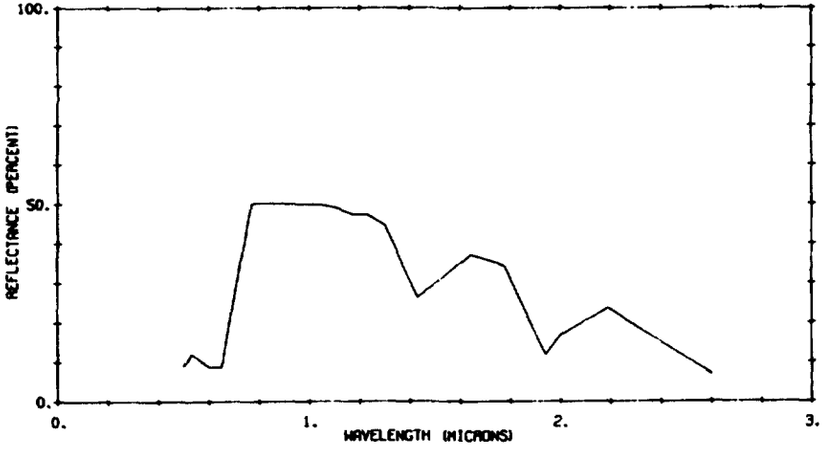
B09007 174

TREE 4, LEAF 3. NO WATER SINCE 18 JUNE.



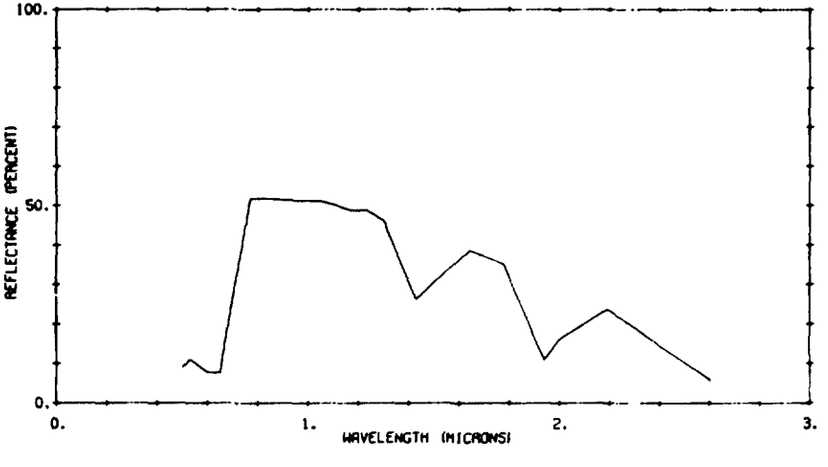
B09007 175

TREE 4, LEAF 1. NO WATER SINCE 18 JUNE.



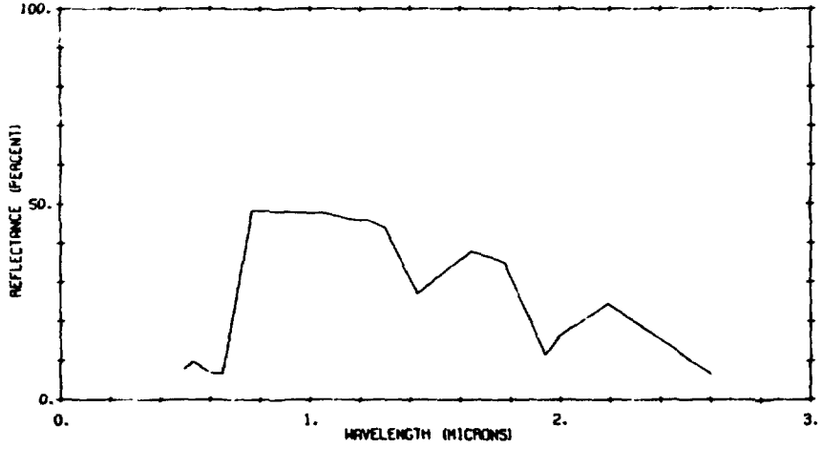
B09007 176

TREE 4, LEAF 2. NO WATER SINCE 18 JUNE.



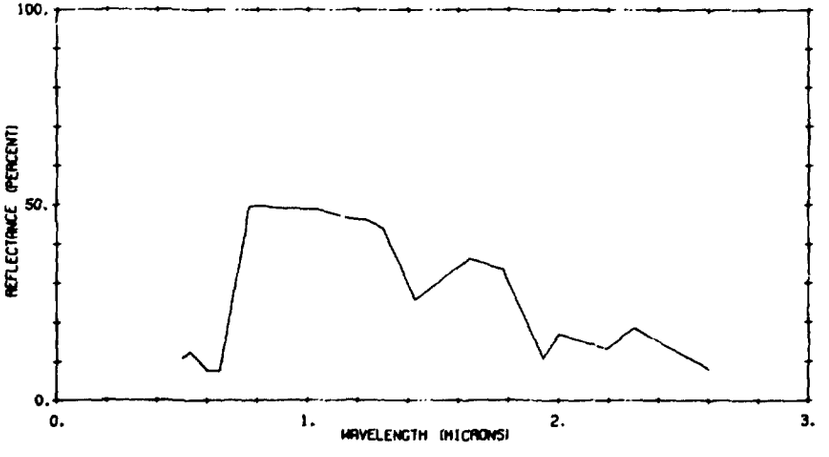
B09007 177

TREE 4, LEAF 3. NO WATER SINCE 18 JUNE.



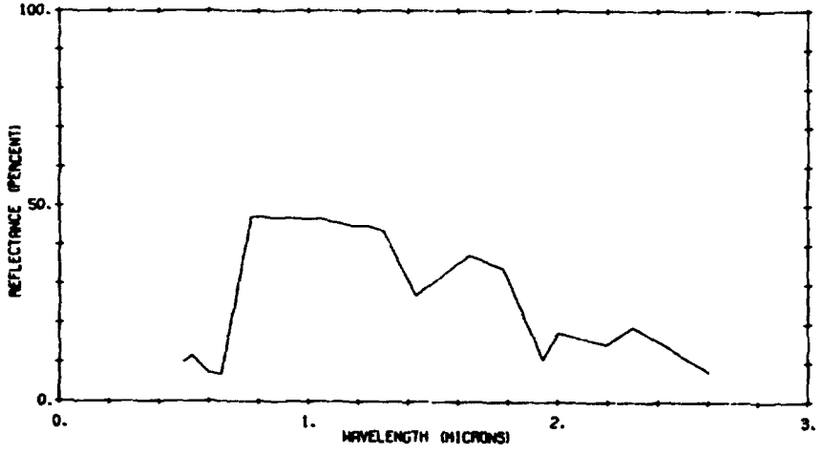
B09007 178

TREE 4, LEAF 1. NO WATER SINCE 18 JUNE.



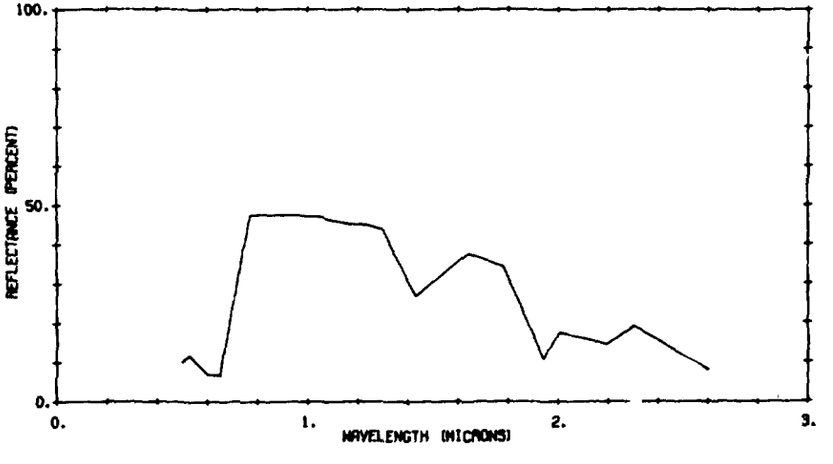
B09007 179

TREE 4, LEAF 2. NO WATER SINCE 18 JUNE.



B09007 180

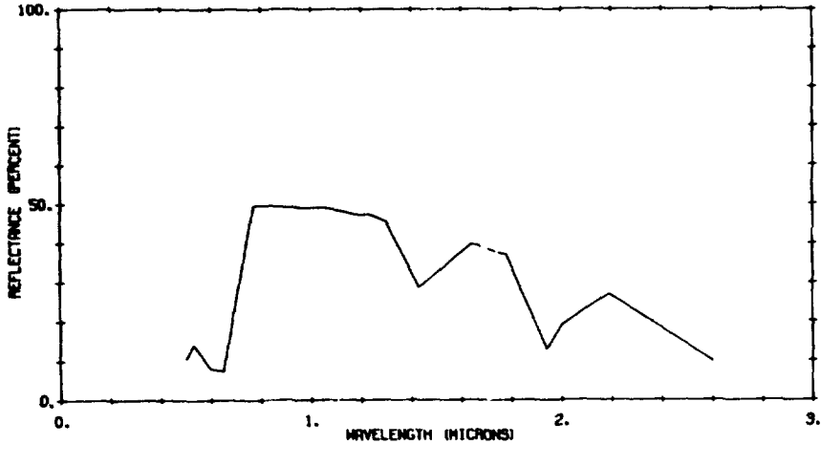
TREE 4, LEAF 3. NO WATER SINCE 18 JUNE.



TREE , LEAF . NO WATER SINCE 18 JUNE.

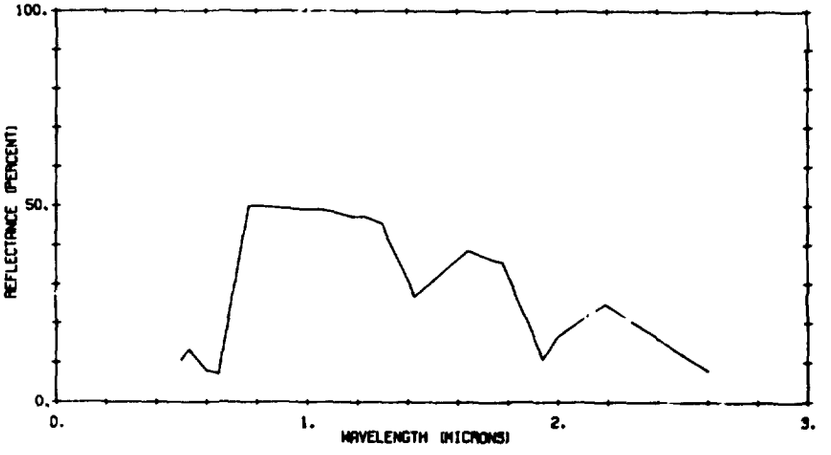
B09007 181

TREE 4, LEAF 1. NO WATER SINCE 18 JUNE.



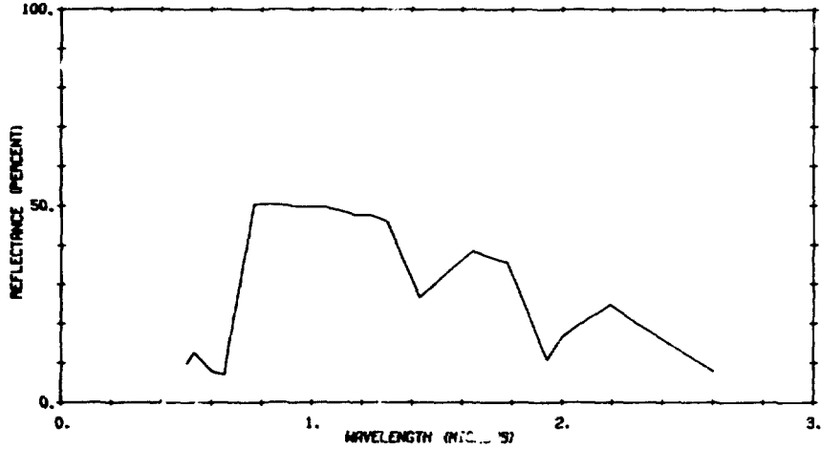
B09007 182

TREE 4, LEAF 2. NO WATER SINCE 18 JUNE.



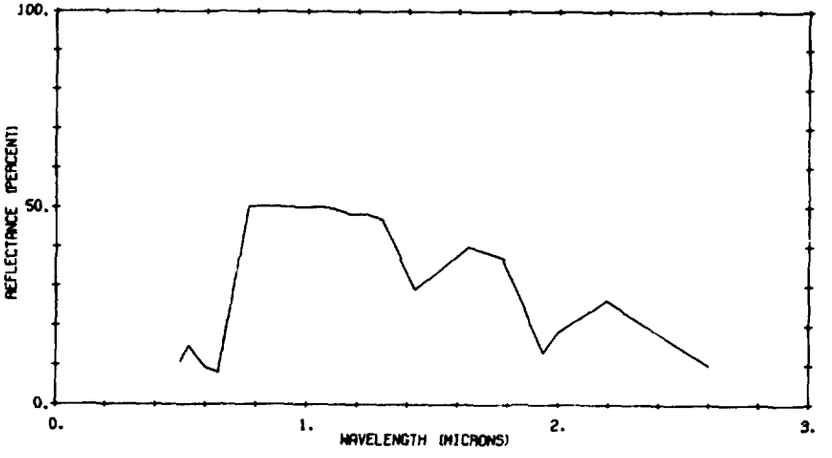
B09007 183

TREE 4, LEAF 3. NO WATER SINCE 18 JUNE.



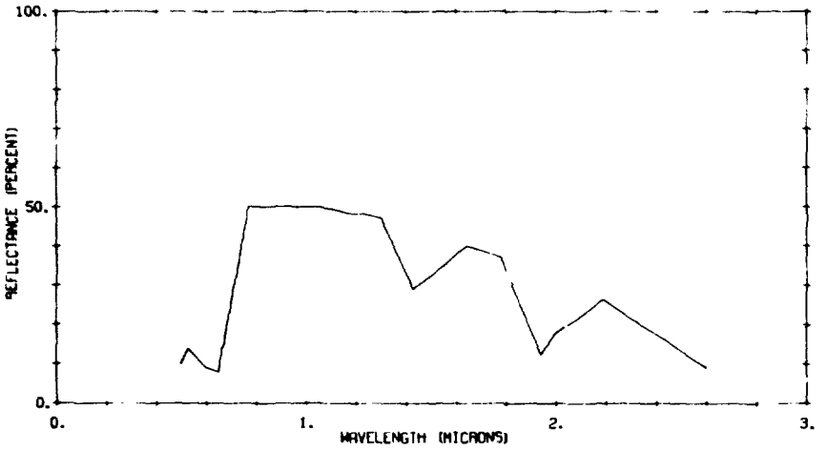
B09007 184

TREE 4, LEAF 1. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



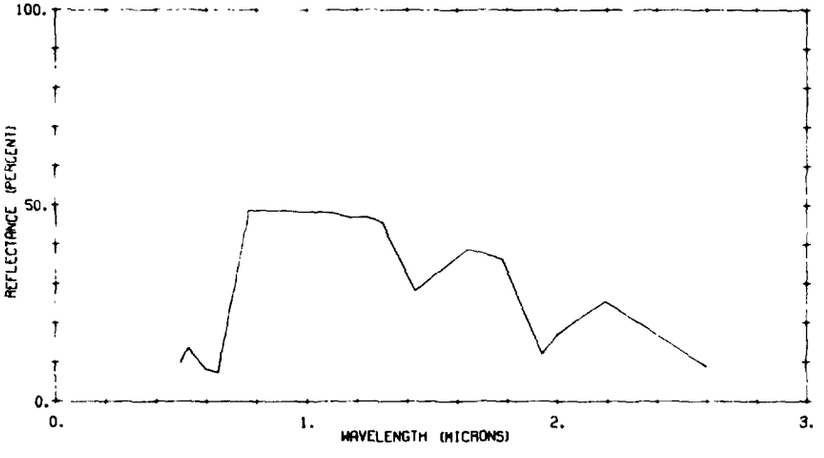
B09007 185

TREE 4, LEAF 2. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



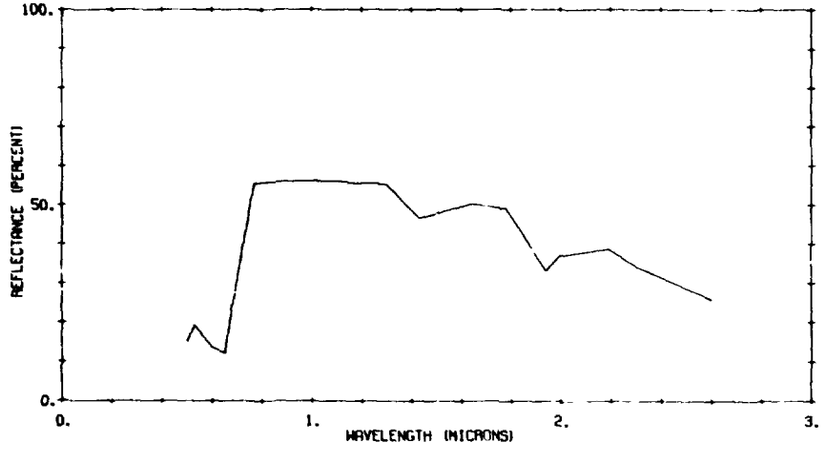
B09007 186

TREE 4, LEAF 3. NO WATER 18 JUNE TO 25 JULY. W, ERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



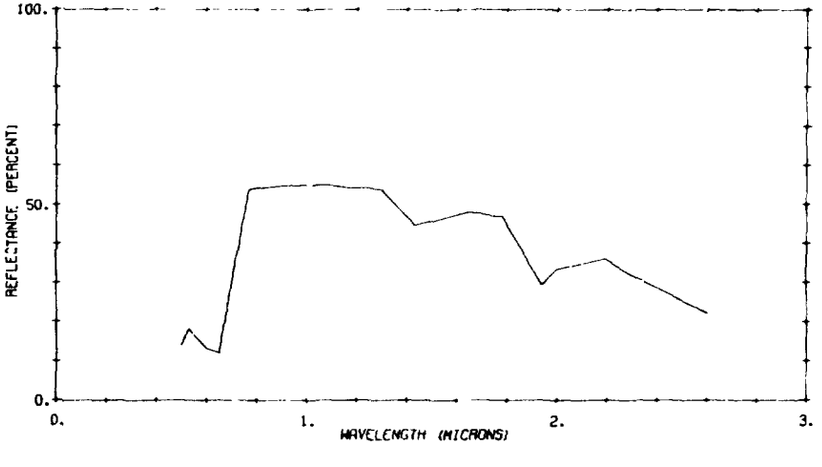
B09007 187

TREE 4, LEAF 1. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



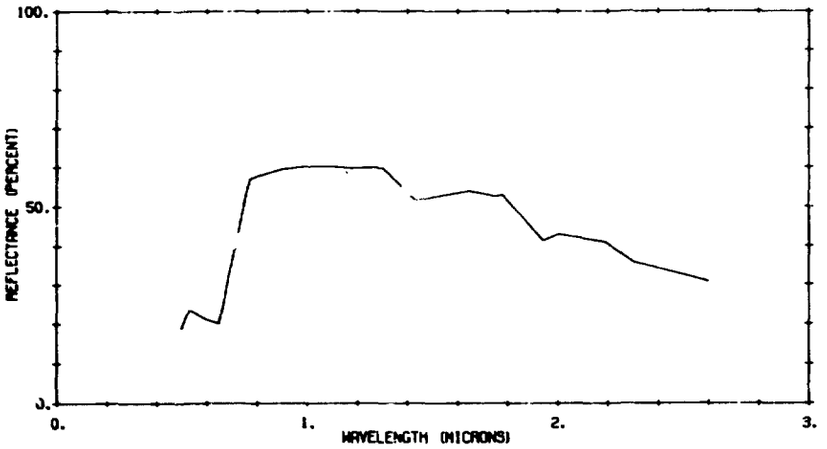
B09007 188

TREE 4, LEAF 2. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



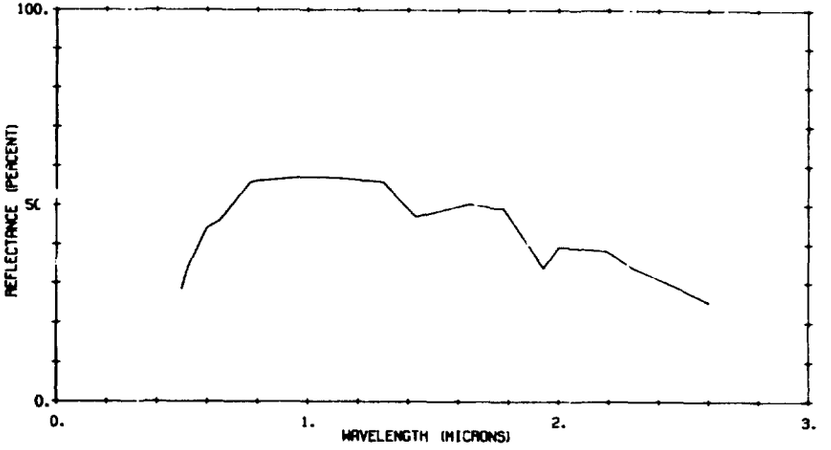
B09007 189

TREE 4, LEAF 3. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



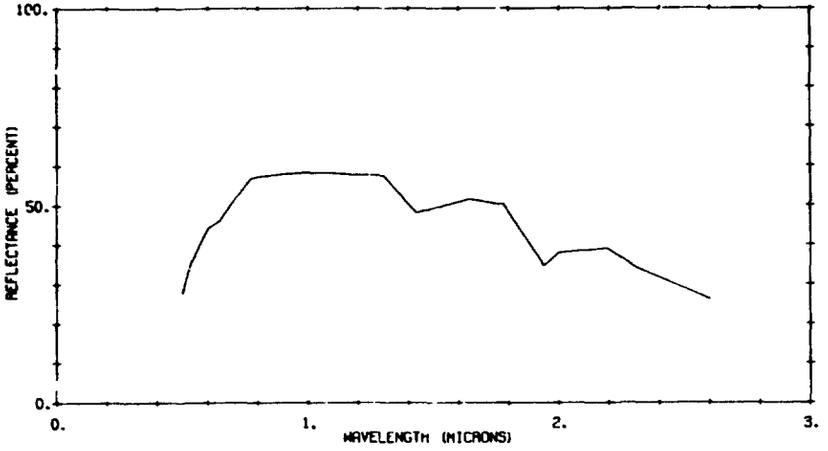
B09007 190

TREE 4, LEAF 1. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



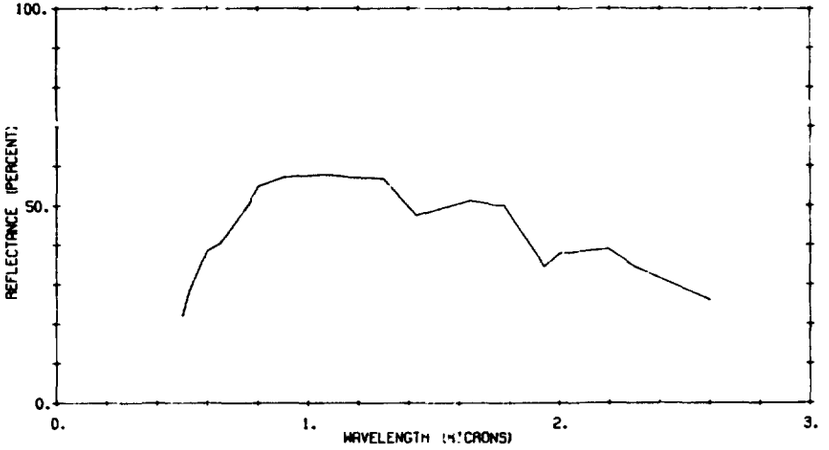
B09007 191

TREE 4, LEAF 2. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



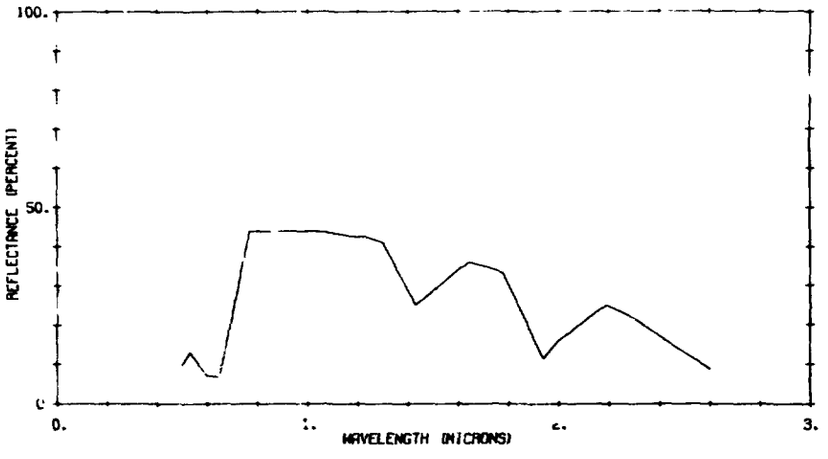
B09007 192

TREE 4 LEAF 3. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



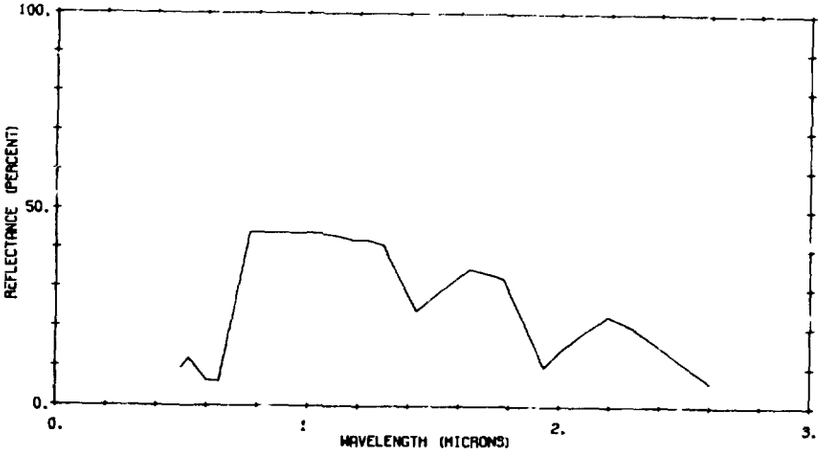
B09007 193

TREE 5, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



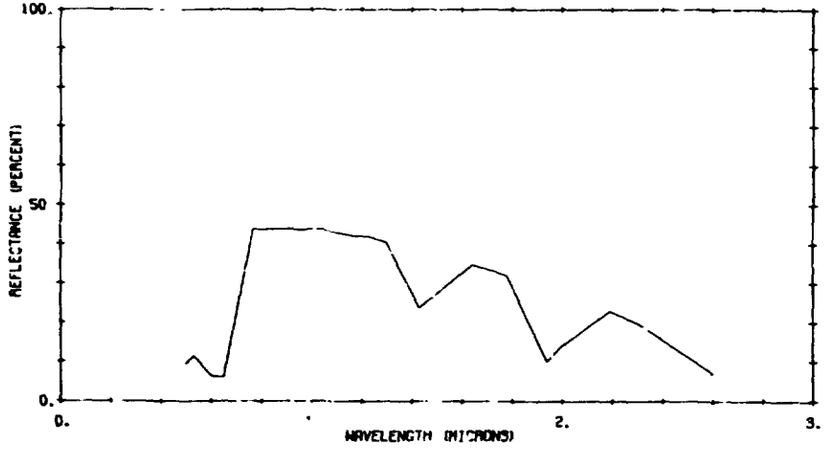
B09007 194

TREE 5, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



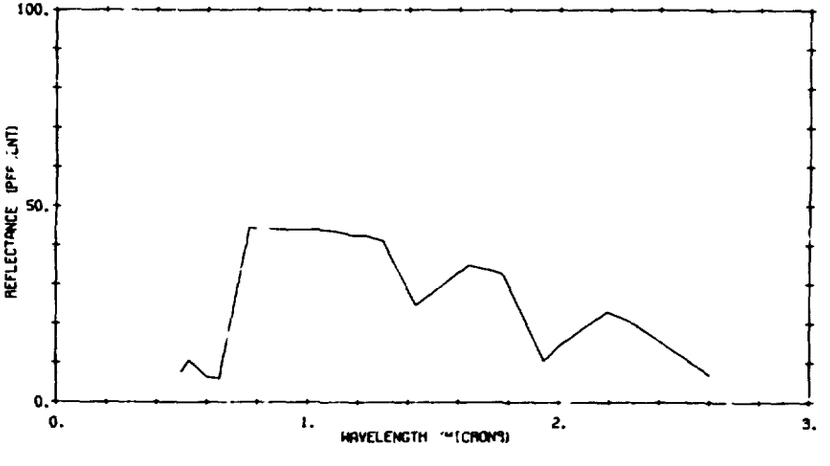
B09007 195

TREE 5, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



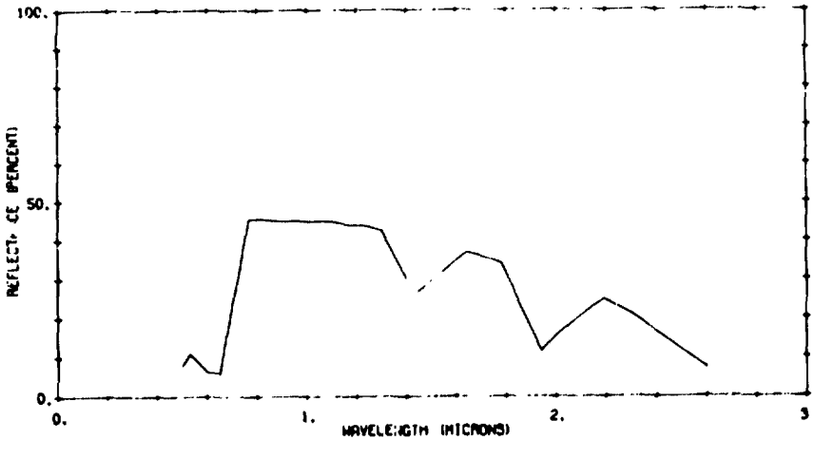
B09007 196

TREE 5, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



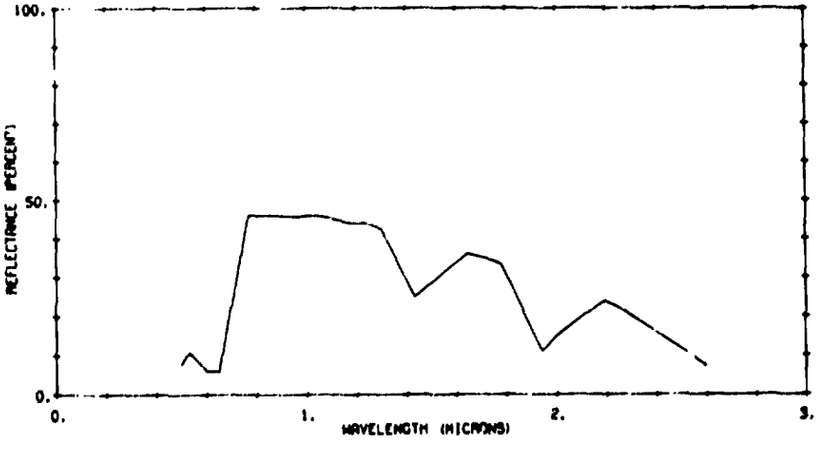
B09007 197

TREE 5, LEAF 2 WATERED EVERY SECOND OR THIRD DAY.



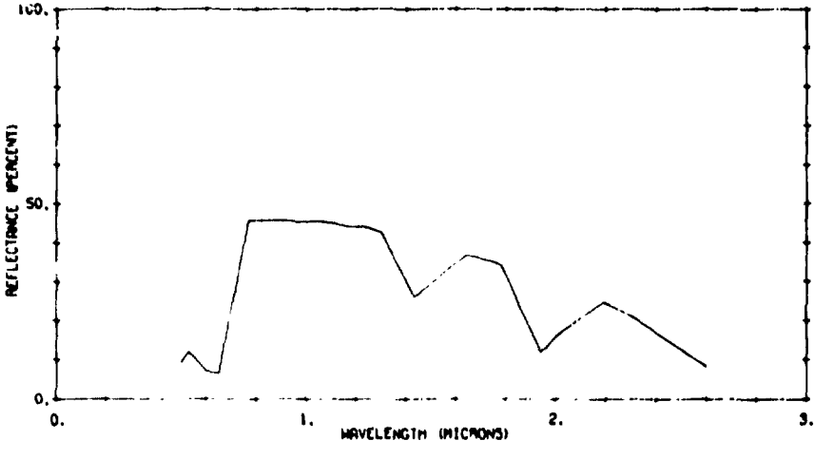
B09007 198

TREE 5, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



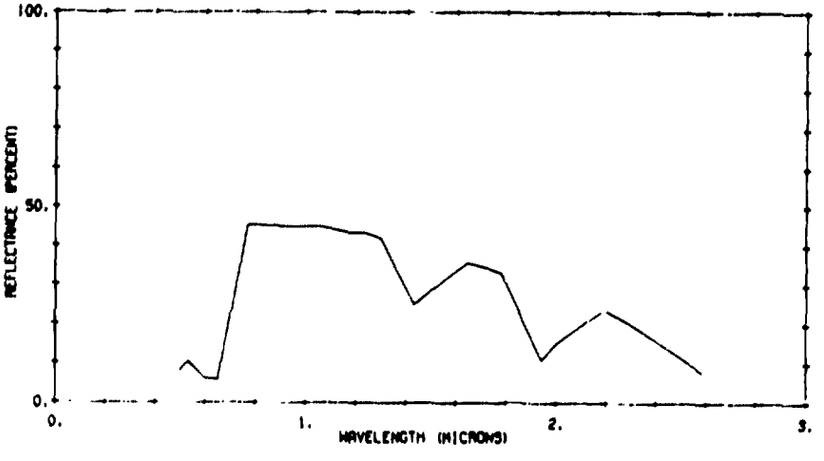
B09007 199

TREE 5, LEAF 1. WATERED EVERY SECOND OR THIRD



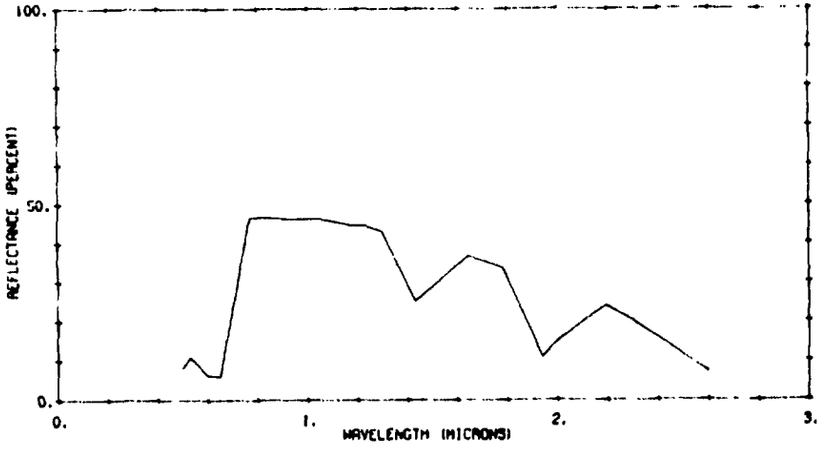
B09007 200

TREE 5, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



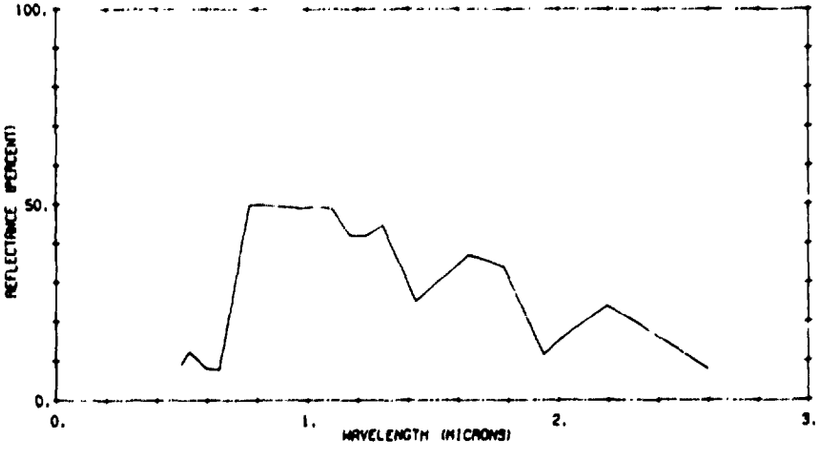
B09007 201

TREE 5, LEAF 3 WATERED EVERY SECOND OR THIRD DAY.



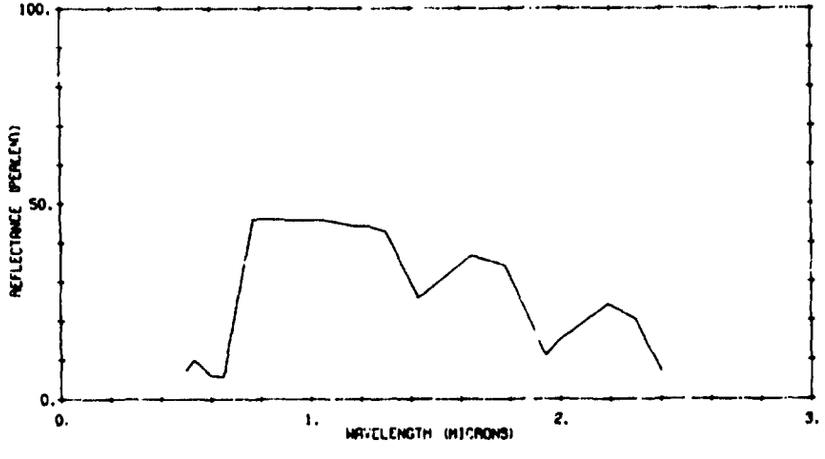
B09007 202

TREE 5, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



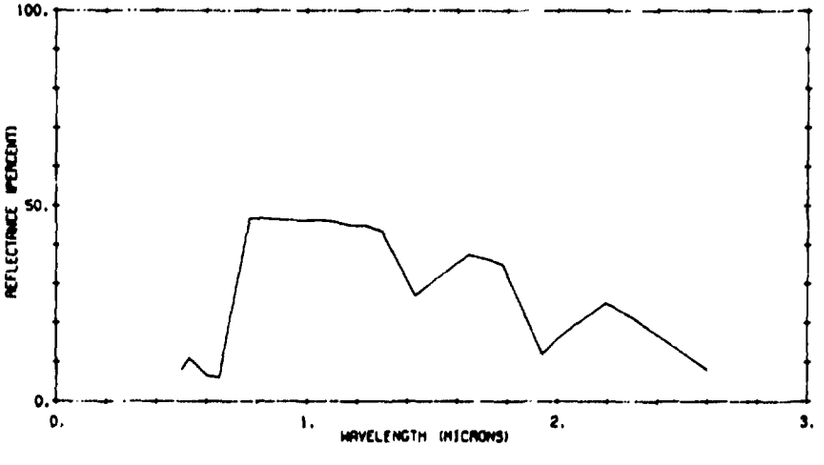
B09007 203

TREE 5, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



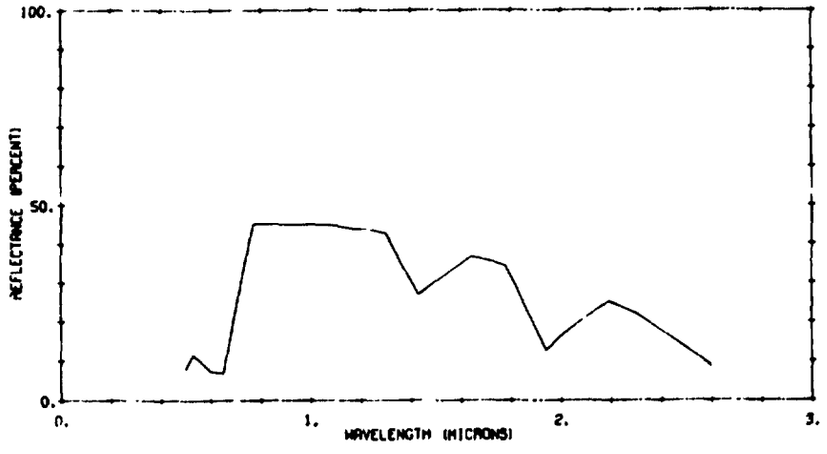
B09007 204

TREE 5, LEAF 4. WATERED EVERY SECOND OR THIRD DAY.



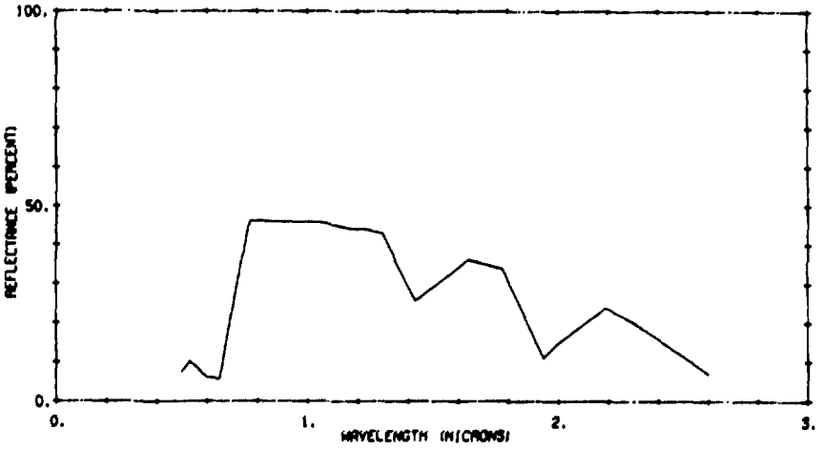
809007 205

TREE 5, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



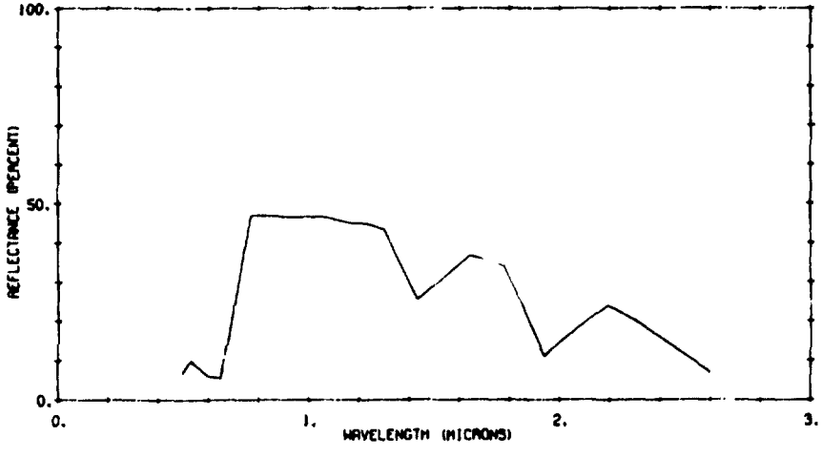
809007 206

TREE 5, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



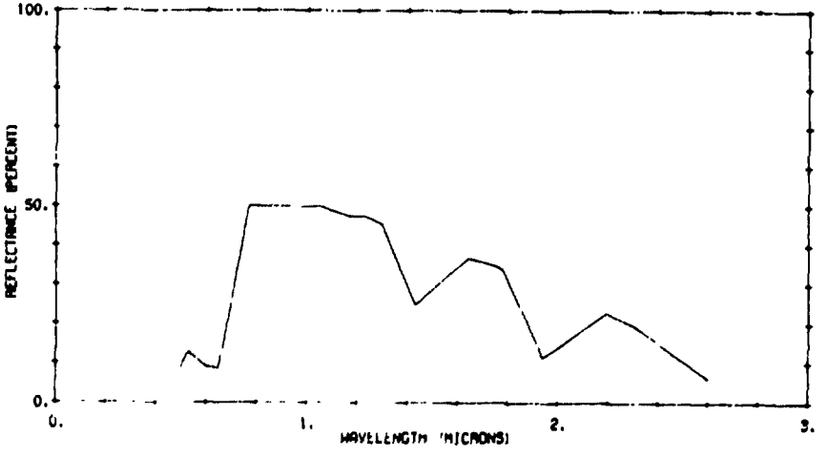
809007 207

TREE 5, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



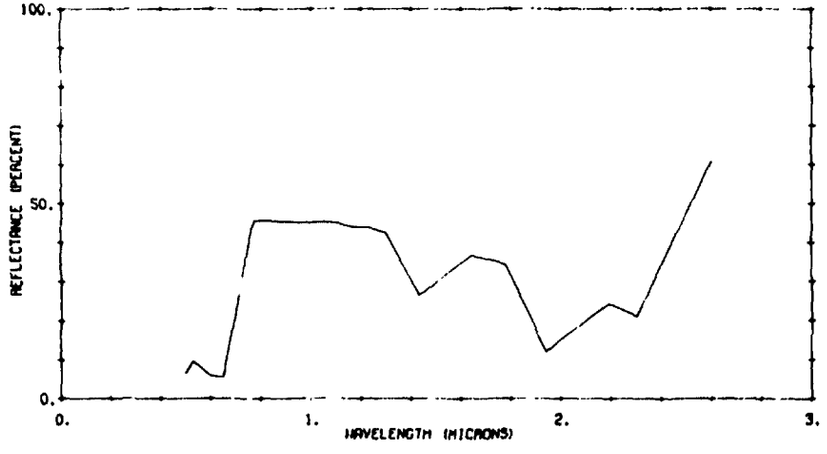
809007 208

TREE 5, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



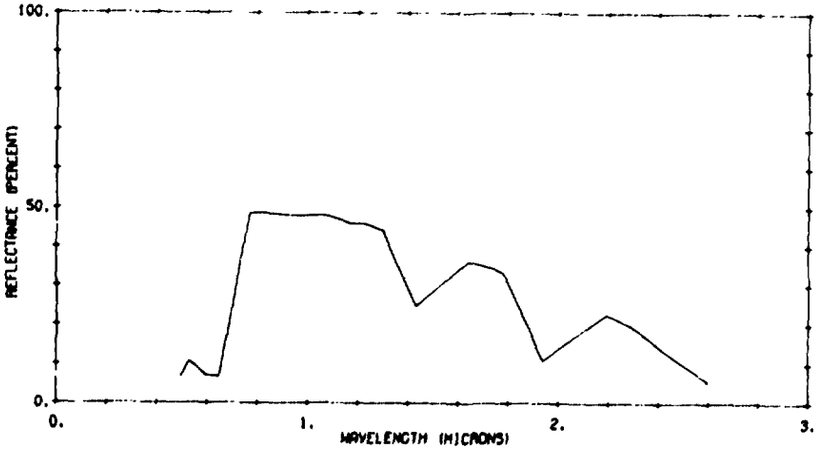
809007 209

TREE 5, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



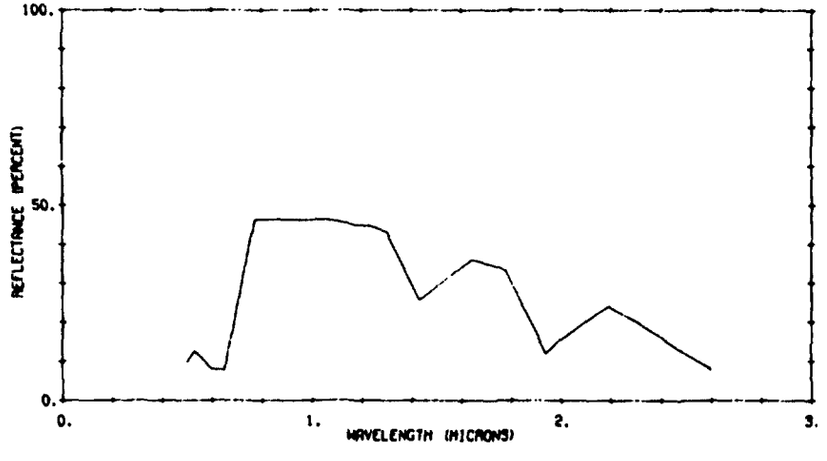
809007 210

TREE 5, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



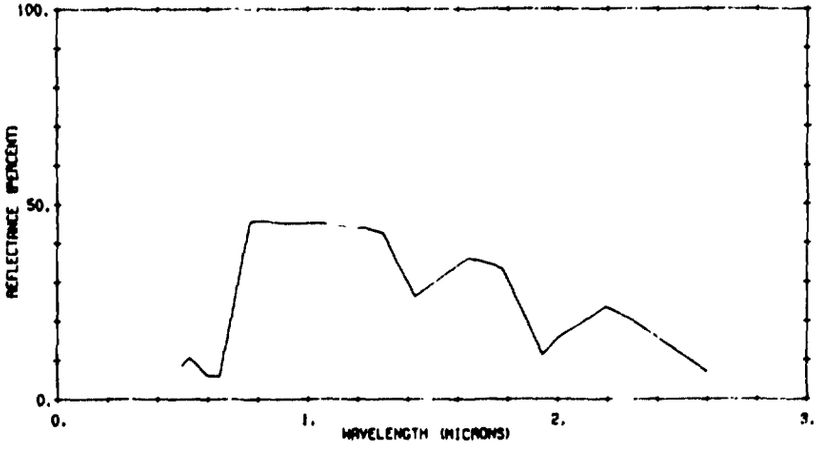
809007 211

TREE 5, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



809007 212

TREE 5, LEAF 2. WATERED EVERY SECOND OR THIRD DAY.

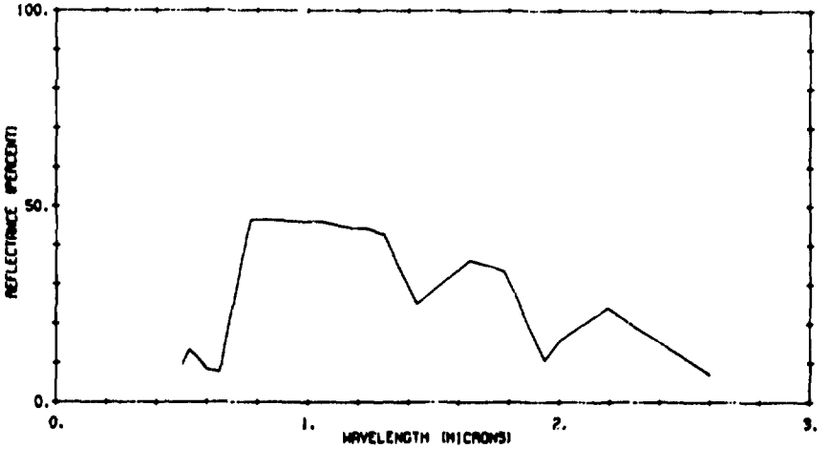


B09007 213

TREE 5, LEAF 3 WATERED EVERY SECOND OR THIRD DAY

B09007 214

TREE 5, LEAF 1. NO WATER SINCE 18 JUNE



B09007 215

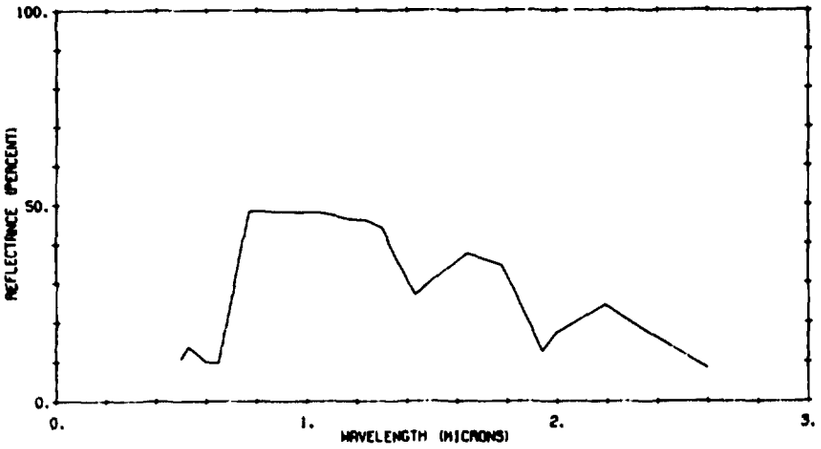
TREE 5, LEAF 2. NO WATER SINCE 18 JUNE.

B09007 216

TREE 5, LEAF 3. NO WATER SINCE 18 JUNE.

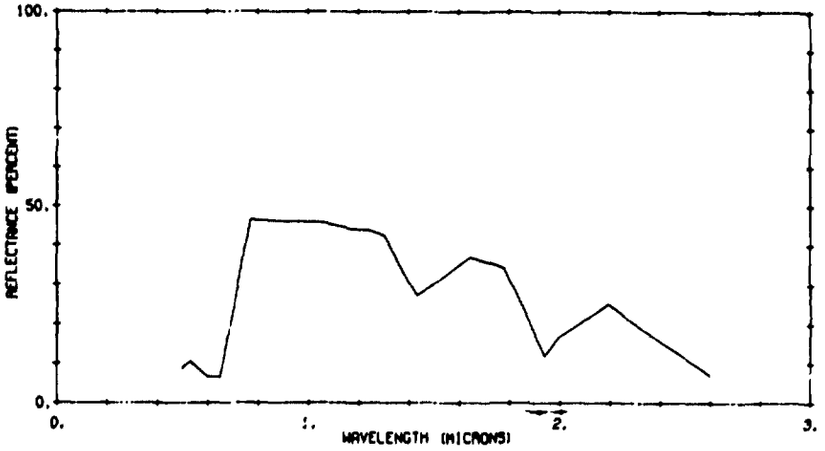
809007 217

TREE 5, LEAF 1 NO WATER SINCE 18 JUNE.



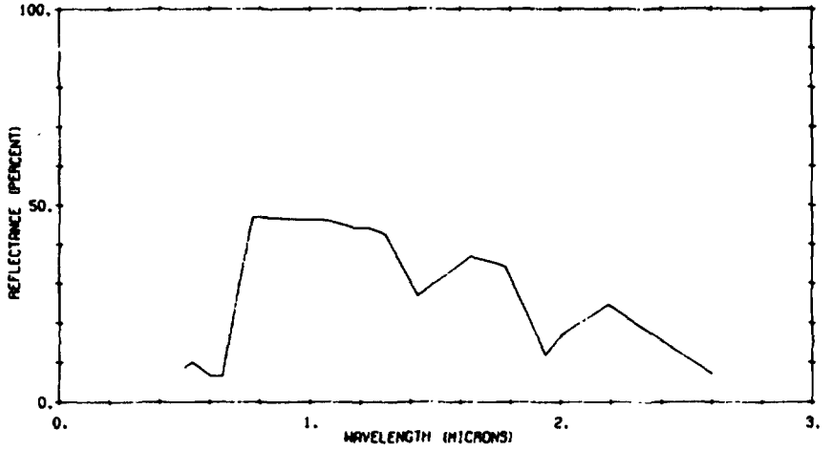
809007 218

TREE 5, LEAF 2. NO WATER SINCE 18 JUNE.



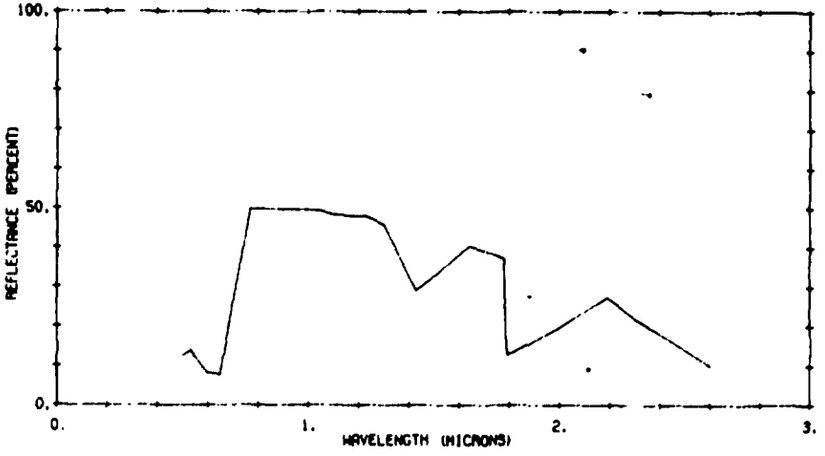
809007 219

TREE 5, LEAF 3. NO WATER SINCE 18 JUNE.



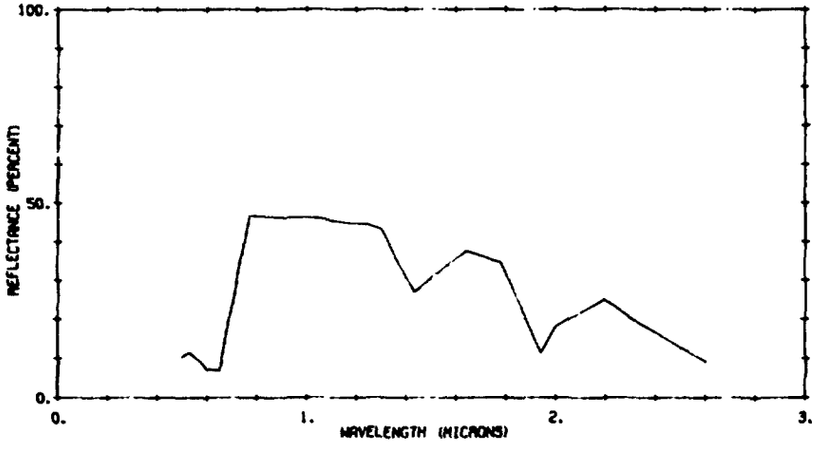
809007 220

TREE 5, LEAF 1. NO WATER SINCE 18 JUNE.



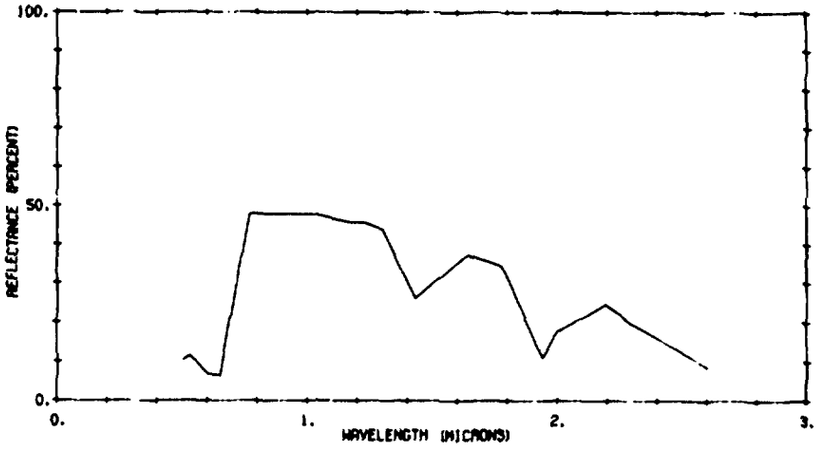
B09007 221

TREE 5, LEAF 2. NO WATER SINCE 18 JUNE.



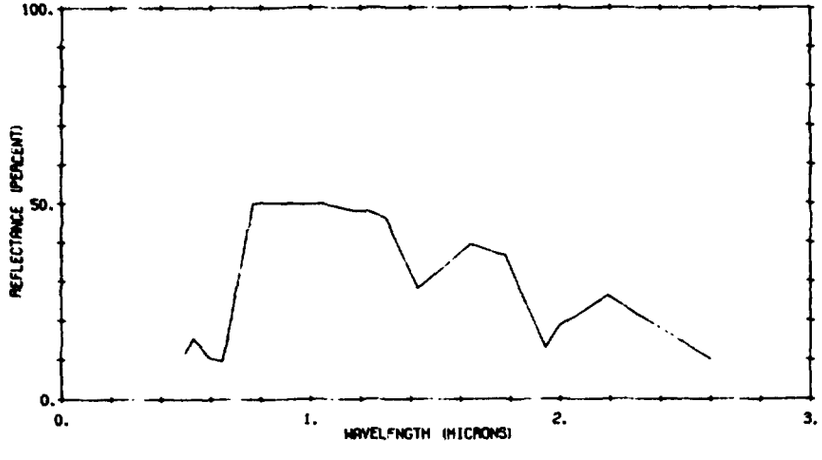
B09007 222

TREE 5, LEAF 3. NO WATER SINCE 18 JUNE.



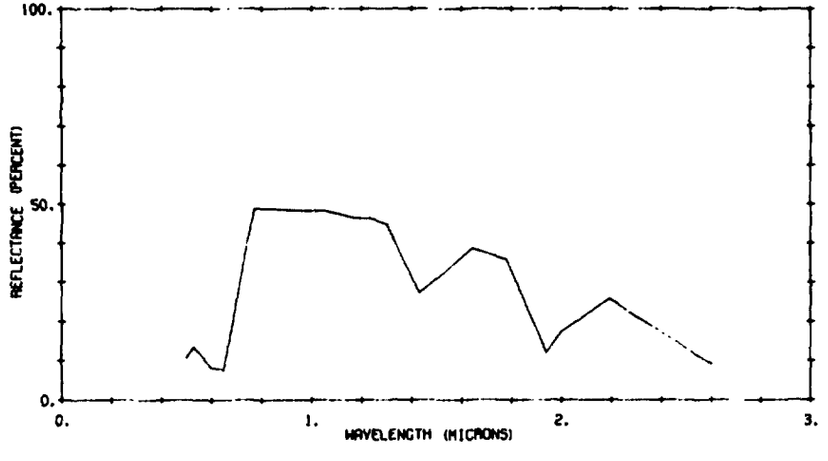
B09007 223

TREE 5, LEAF 1. NO WATER SINCE 18 JUNE.



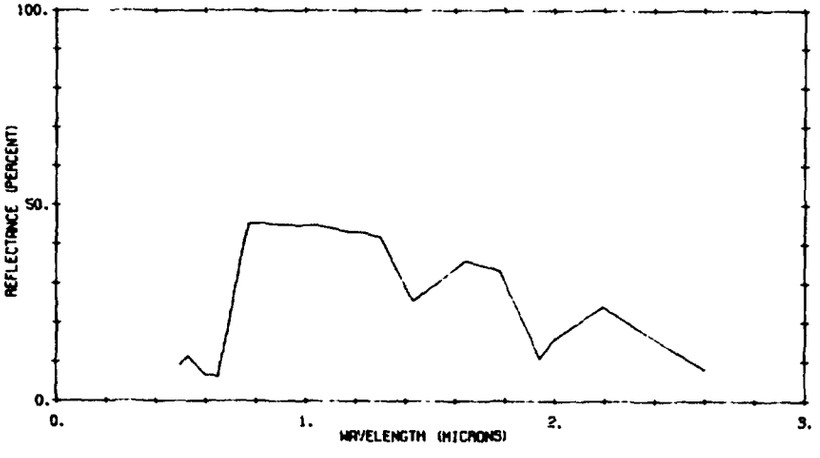
B09007 224

TREE 5, LEAF 2. NO WATER SINCE 18 JUNE.



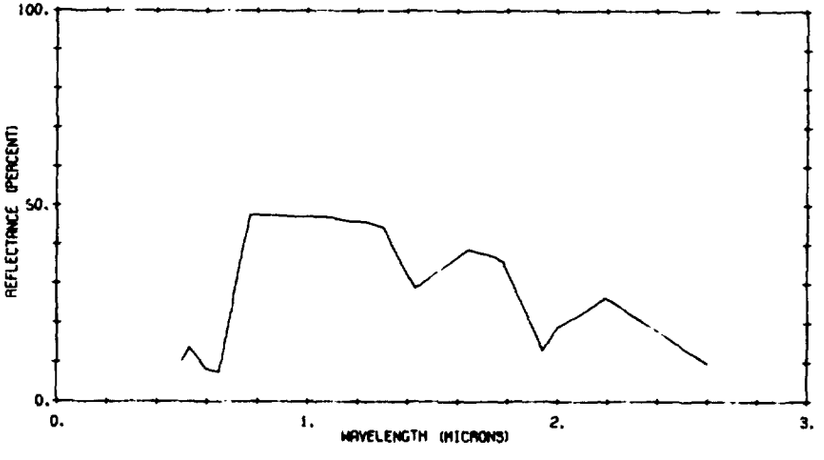
B09007 225

TREE 5, LEAF 3. NO WATER SINCE 18 JUNE.



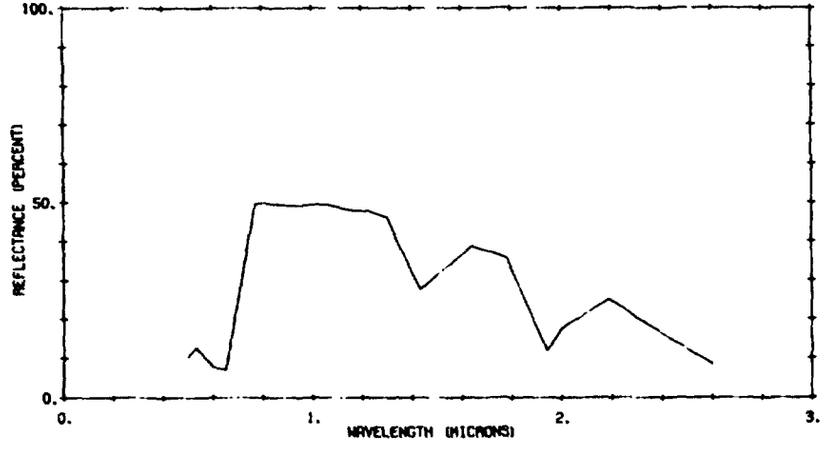
B09007 226

TREE 5, LEAF 1. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



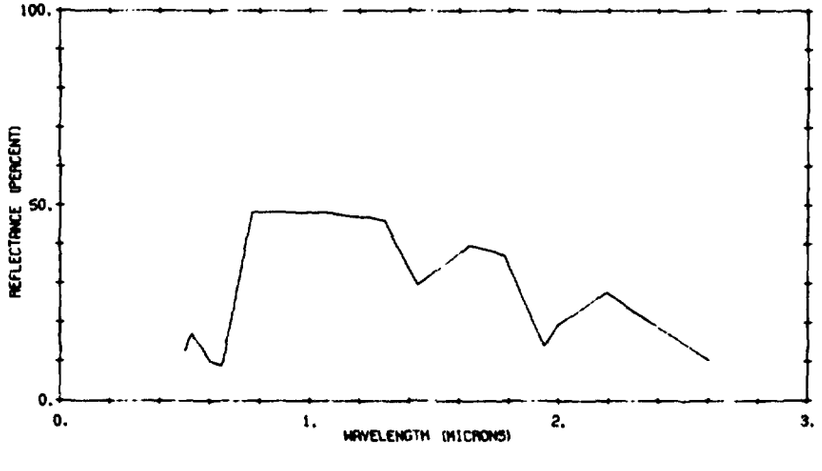
B09007 227

TREE 5, LEAF 2. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



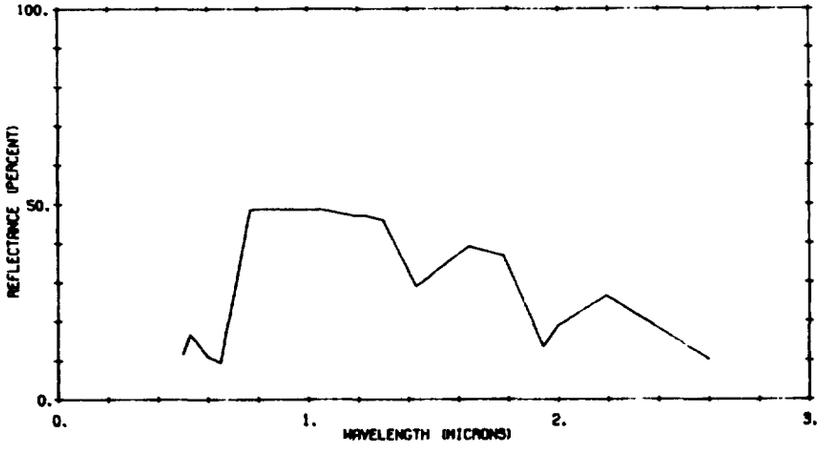
B09007 228

TREE 5, LEAF 3. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



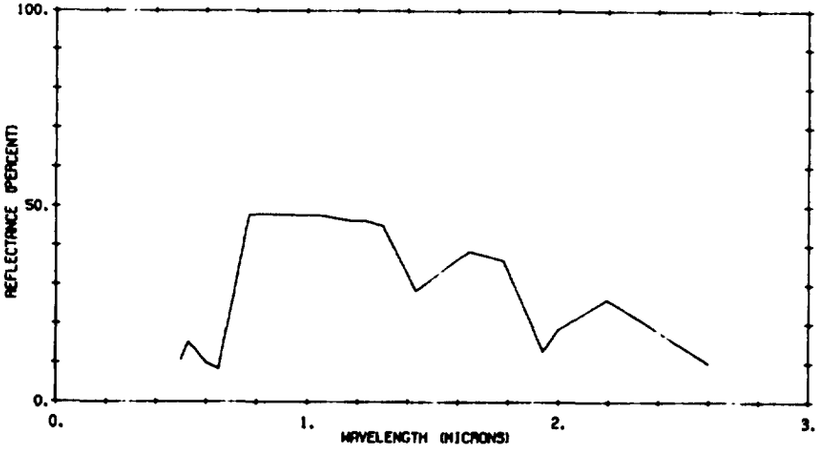
B09007 229

TREE 5, LEAF 1. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



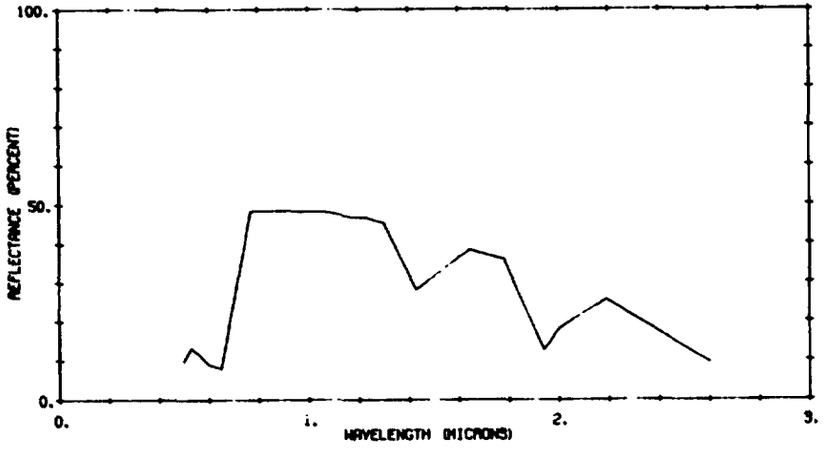
B09007 230

TREE 5, LEAF 2. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



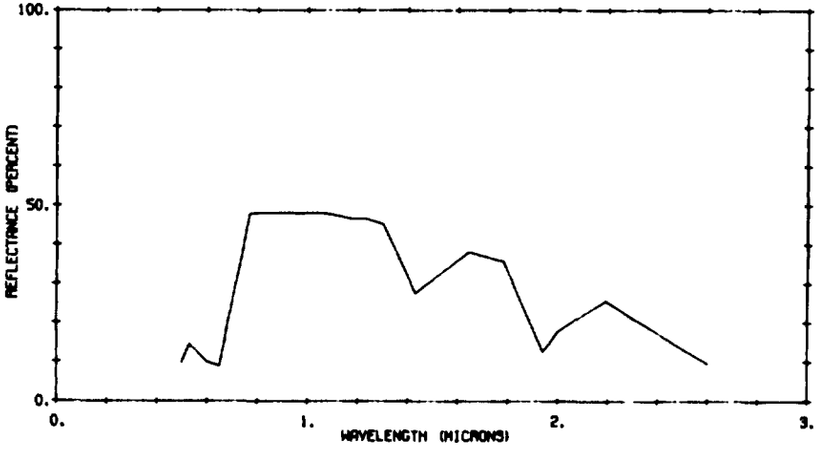
B09007 231

TREE 5, LEAF 3. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



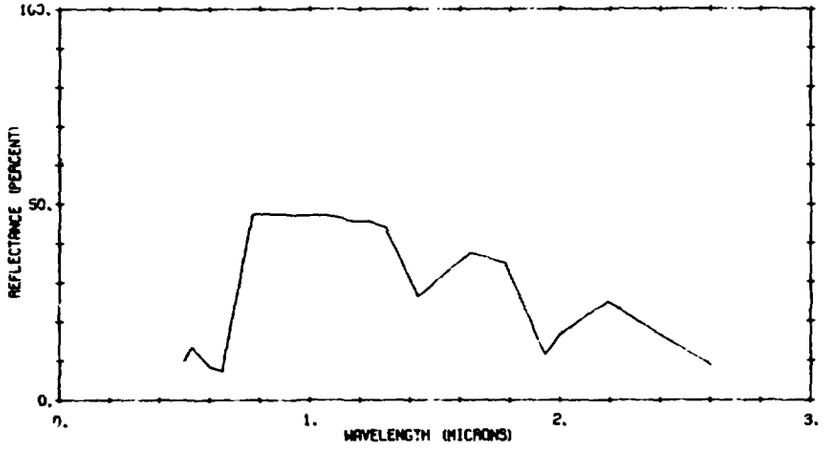
B09007 232

TREE 5, LEAF 1. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



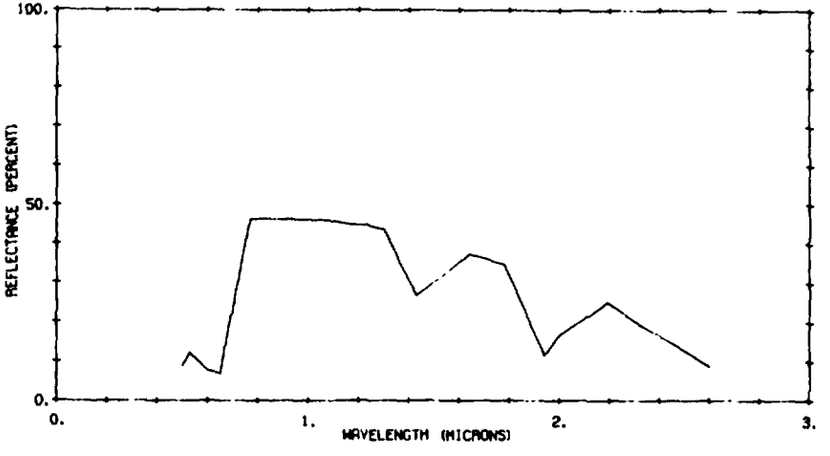
B09007 233

TREE 5, LEAF 2. NO WATER 18 JUNE TO 25 JULY. WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER.



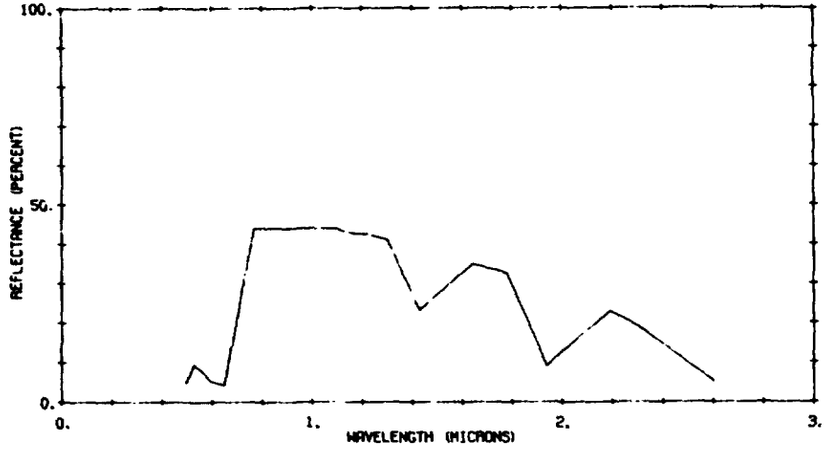
B09007 234

TREE 5, LEAF 3 NO WATER 18 JUNE TO 25 JULY WATERED ON 26 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER



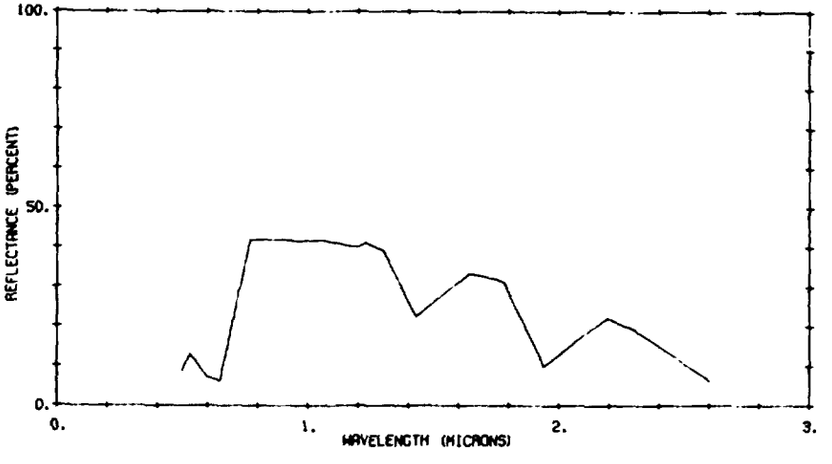
B09007 235

TREE 6, LEAF 1 NO WATER SINCE 1 MAY.



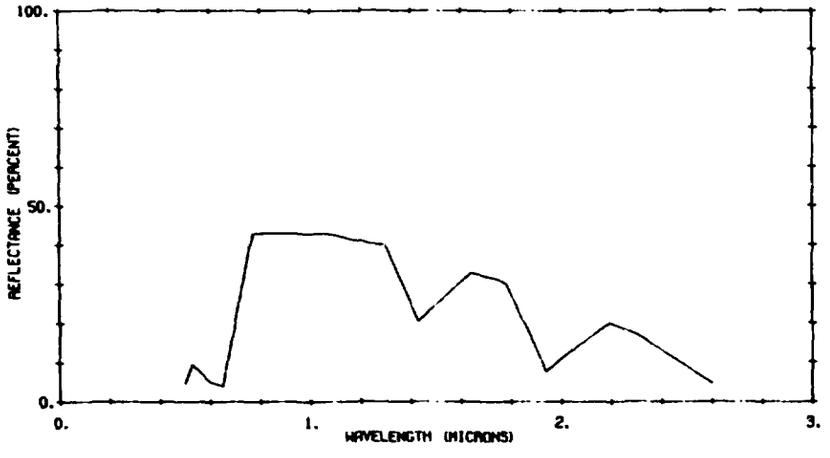
B09007 236

TREE 6, LEAF 2. NO WATER SINCE 1 MAY



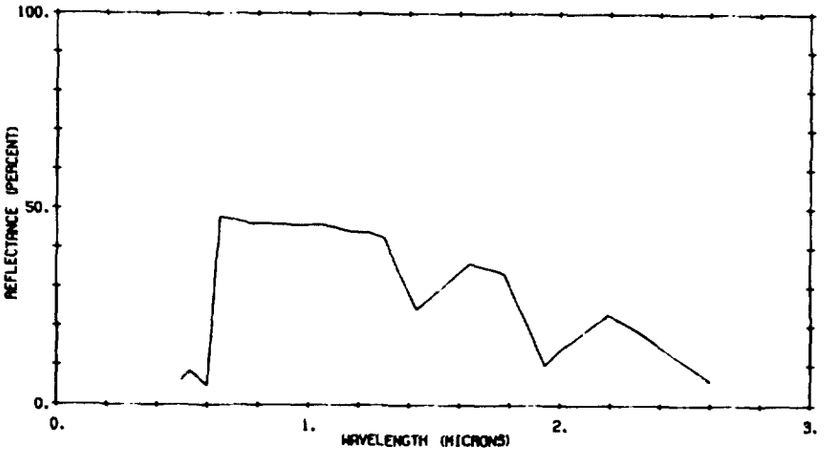
B09007 237

TREE 6, LEAF 3. NO WATER SINCE 1 MAY



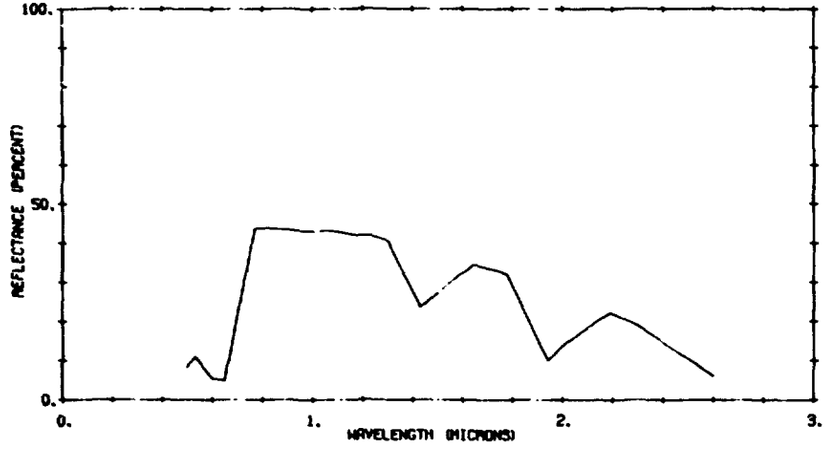
B09007 238

TREE 6, LEAF 1. NO WATER SINCE 1 MAY



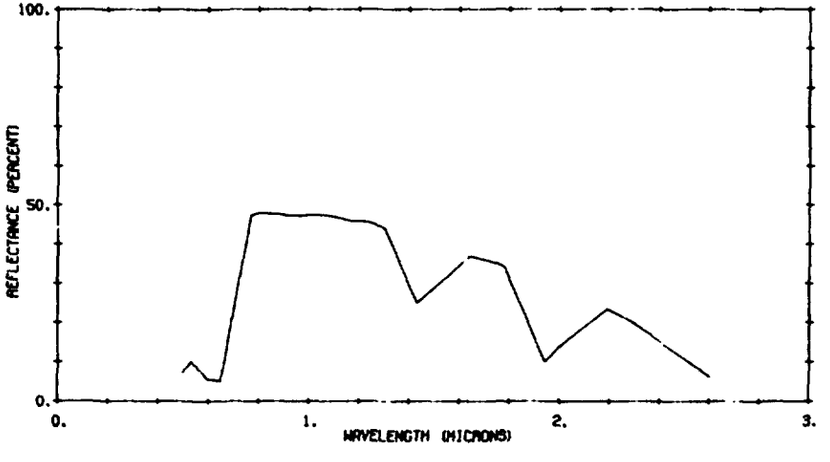
B09007 239

TREE 6, LEAF 2. NO WATER SINCE 1 MAY.



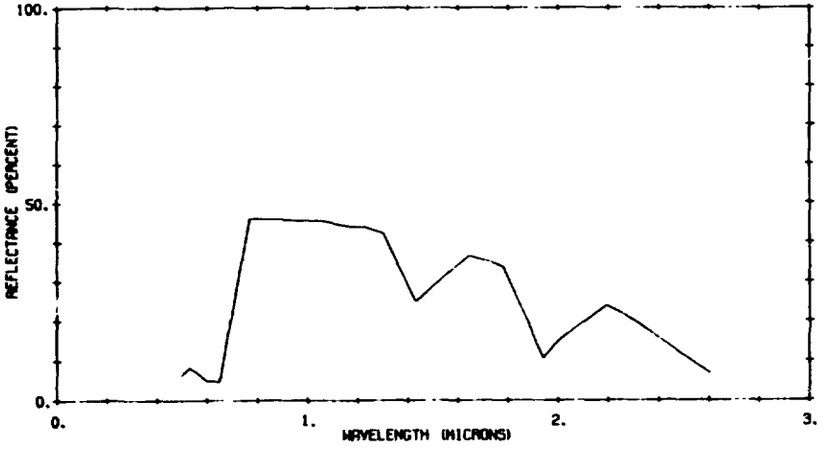
B09007 240

TREE 6, LEAF 3. NO WATER SINCE 1 MAY.



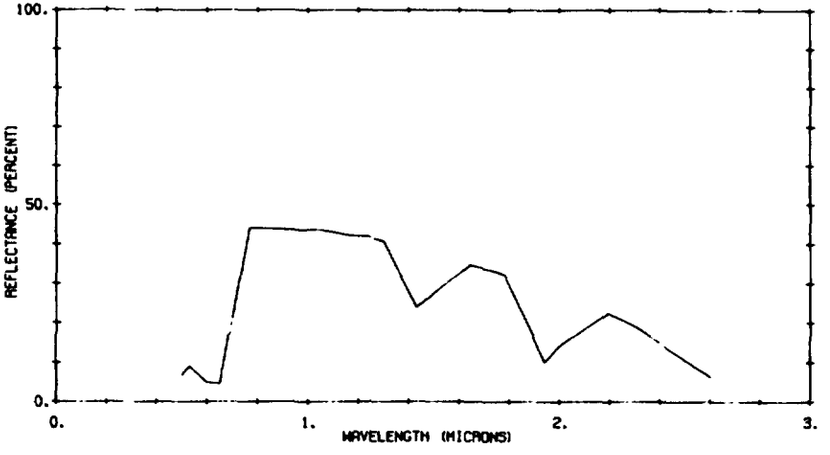
B09007 241

TREE 6, LEAF 1. NO WATER SINCE 1 MAY.



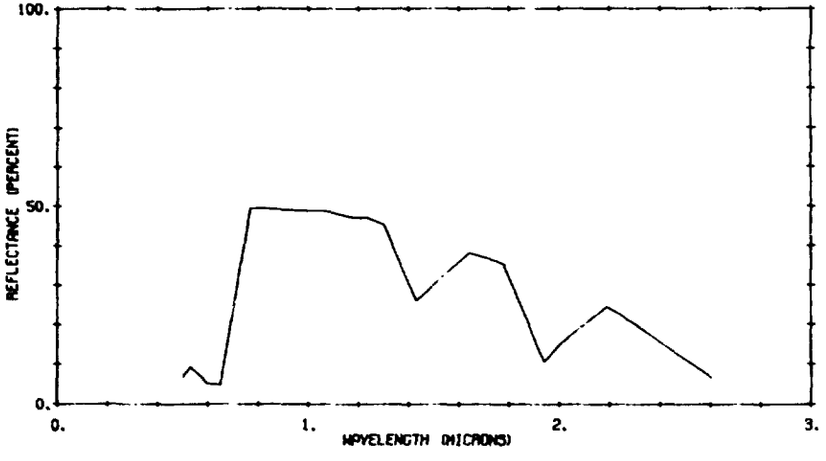
B09007 242

TREE 6, LEAF 2. NO WATER SINCE 1 MAY.



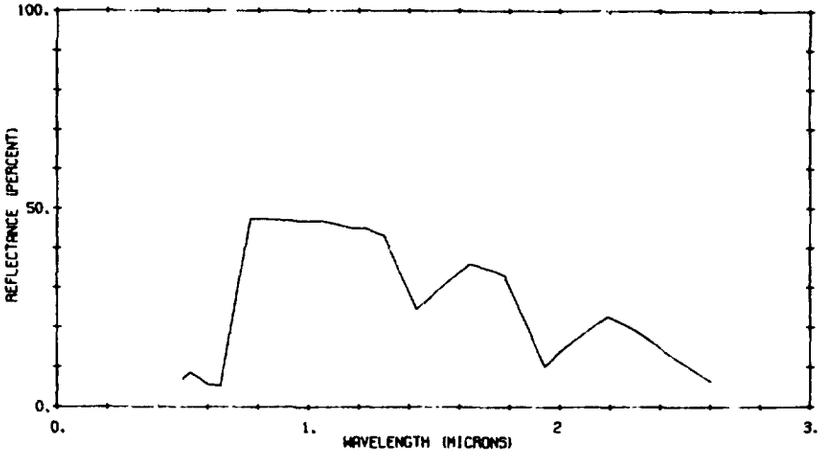
B09007 243

TREE 6, LEAF 3. NO WATER SINCE 1 MAY



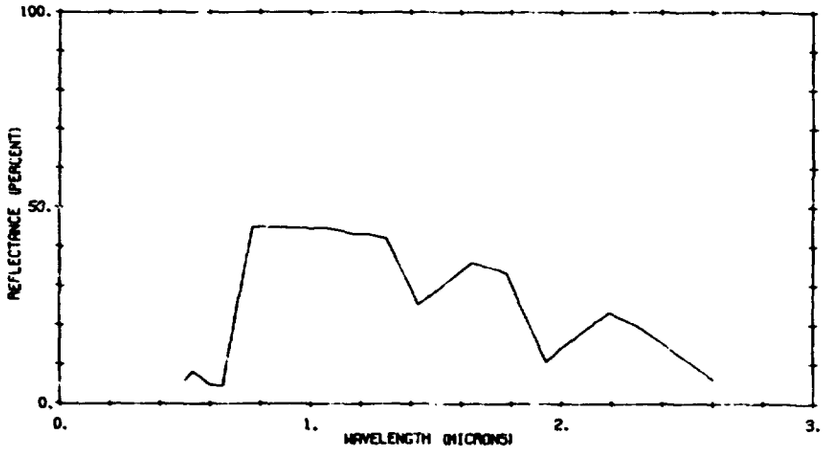
B09007 244

TREE 6, LEAF 1. NO WATER SINCE 1 MAY.



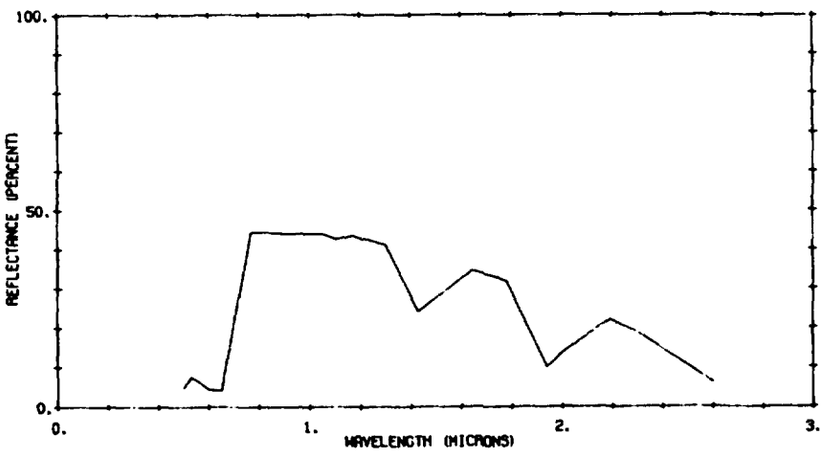
B09007 245

TREE 6, LEAF 2. NO WATER SINCE 1 MAY.



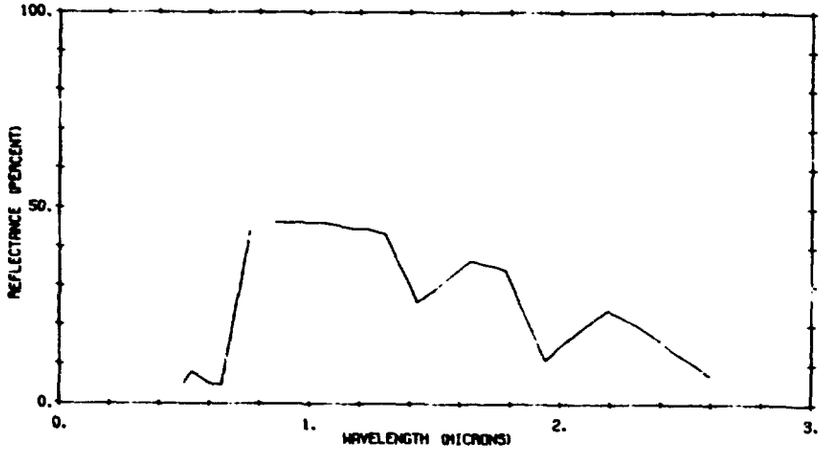
B09007 246

TREE 6, LFAF 3. NO WATER SINCE 1 MAY.



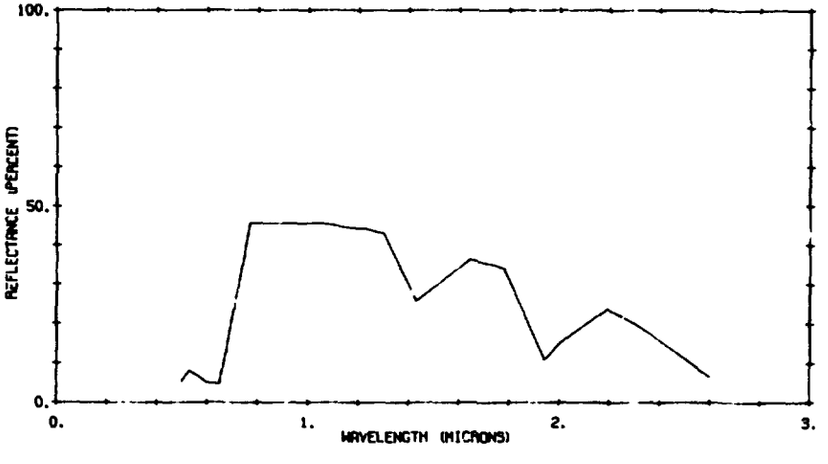
B09007 247

TREE 6, LEAF 1. NO WATER SINCE 1 MAY.



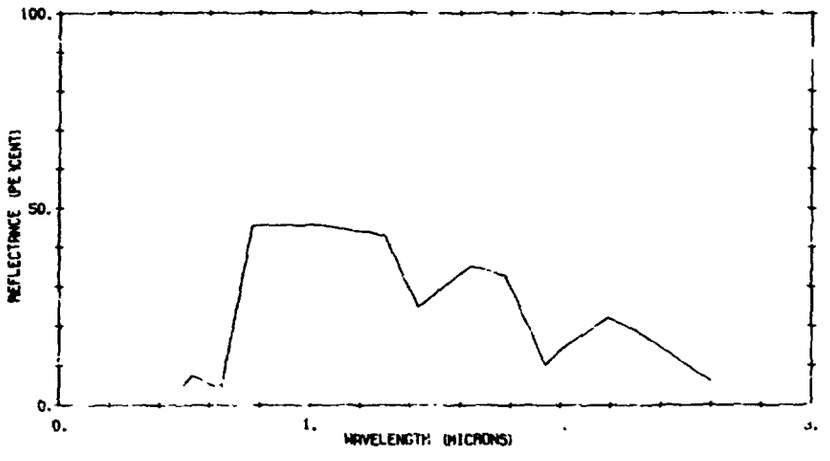
B09007 248

TREE 6, LEAF 2. NO WATER SINCE 1 MAY.



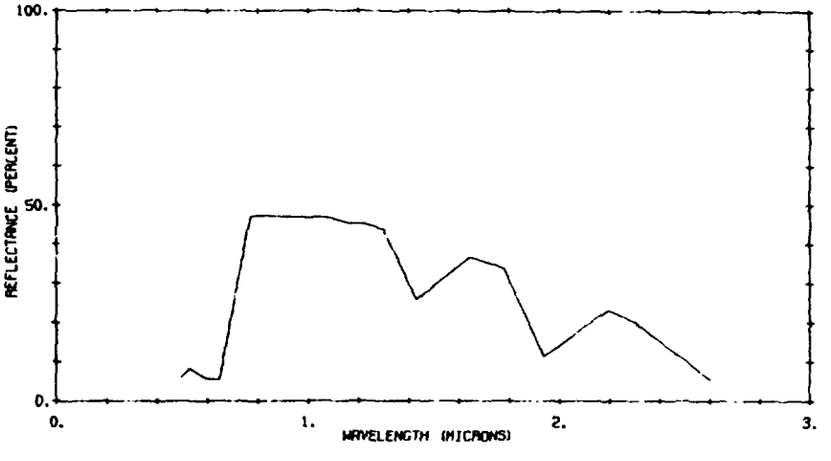
B09007 249

TREE 6, LEAF 3. NO WATER SINCE 1 MAY.



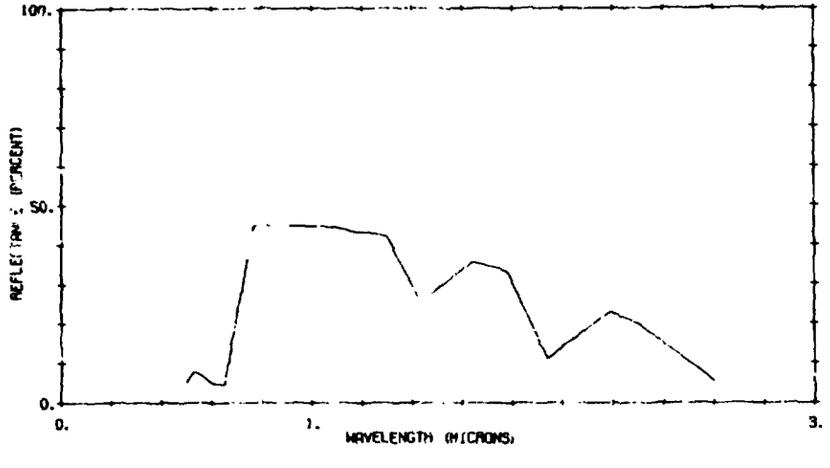
B09007 250

TREE 6, LEAF 1. NO WATER SINCE 1 MAY



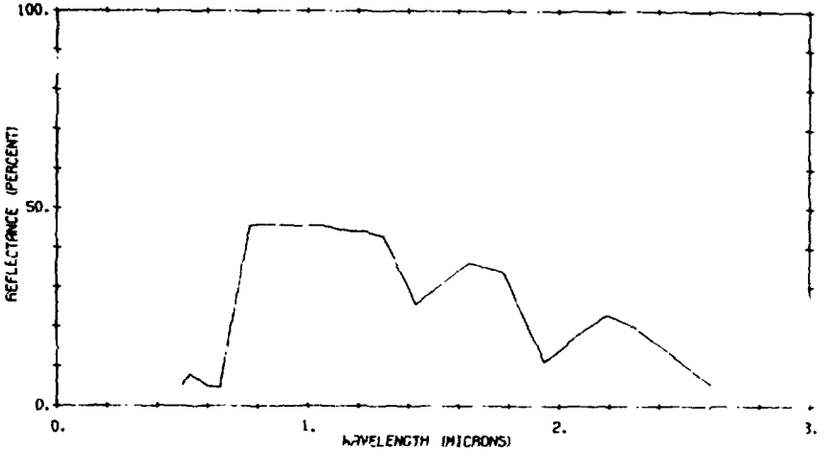
B09007 251

TREE 6 LEAF 2. NO WATER SINCE 1 MAY.



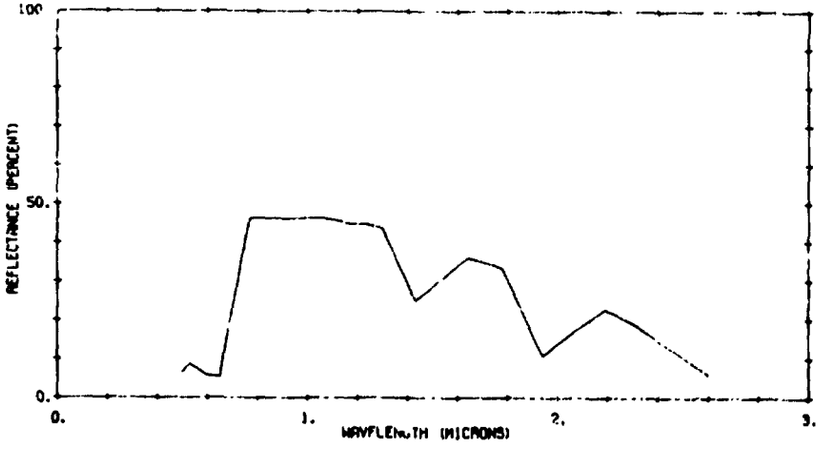
B09007 252

TREE 6, LEAF 3. NO WATER SINCE 1 MAY.



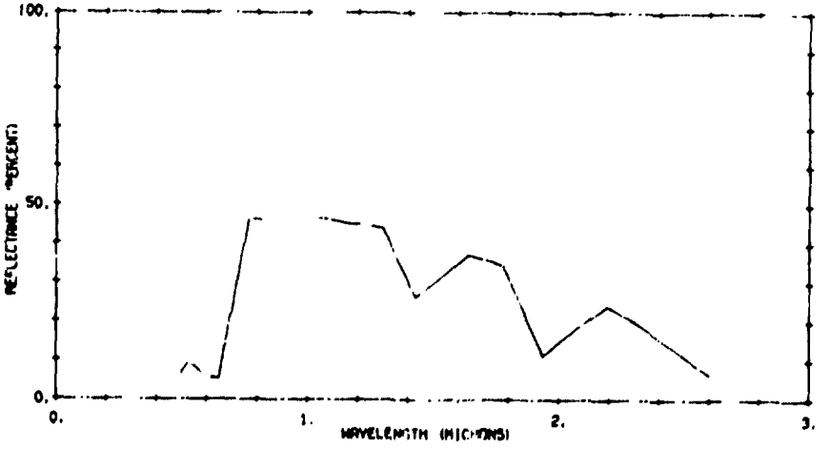
B09007 253

TREE 6 LEAF 1 NO WATER SINCE 1 MAY



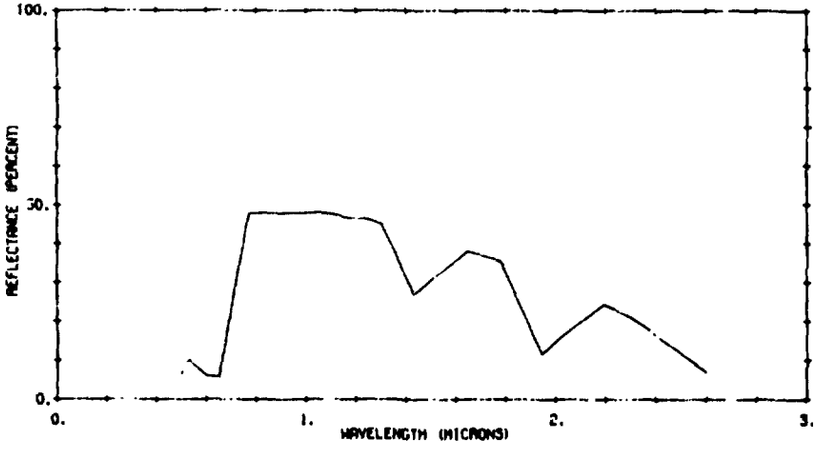
B09007 254

TREE 6, LEAF 2. NO WATER SINCE 1 MAY



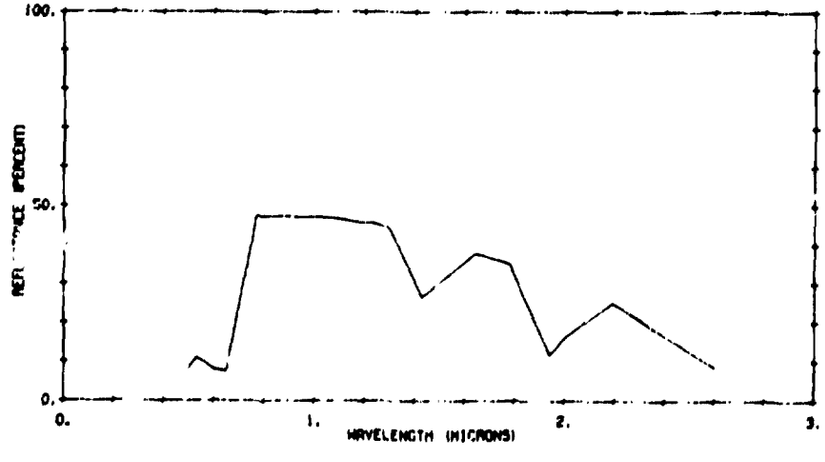
B09007 255

TREE 6, LEAF 3. NO WATER SINCE 1 MAY



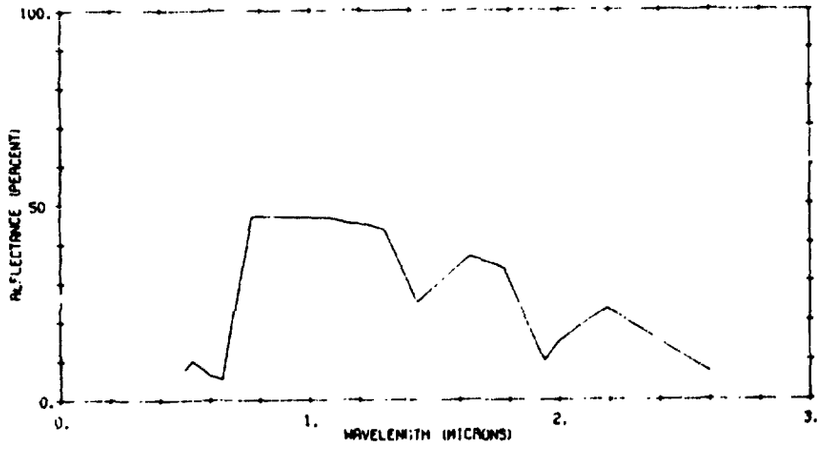
B09007 256

TREE 6, LEAF 1 NO WATER SINCE 1 MAY



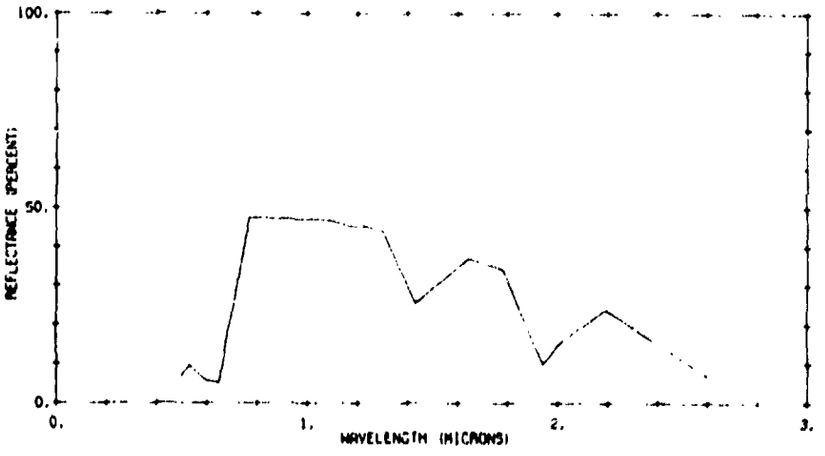
B09007 257

TREE 6, LEAF 2, NO WATER SINCE 1 MAY



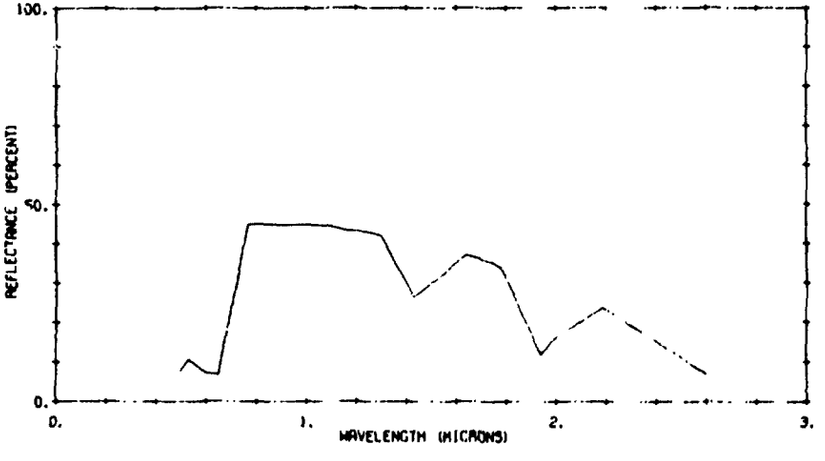
B09007 258

TREE 6, LEAF 3, NO WATER SINCE 1 MAY



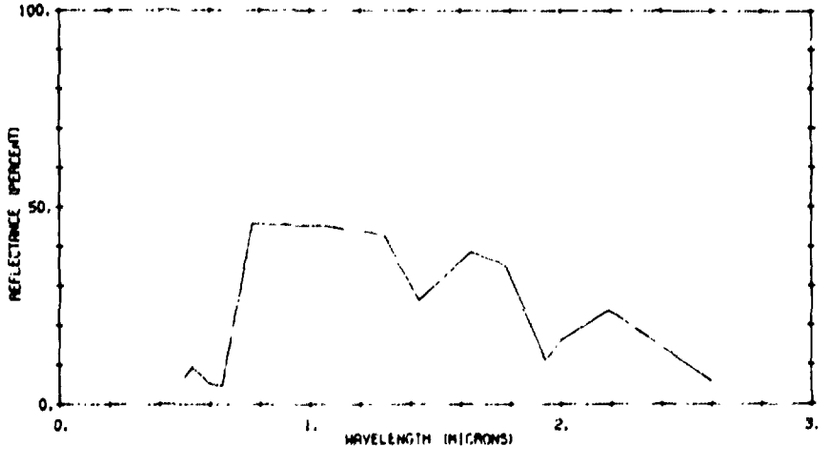
B09007 259

TREE 6, LEAF 1, NO WATER SINCE 1 MAY



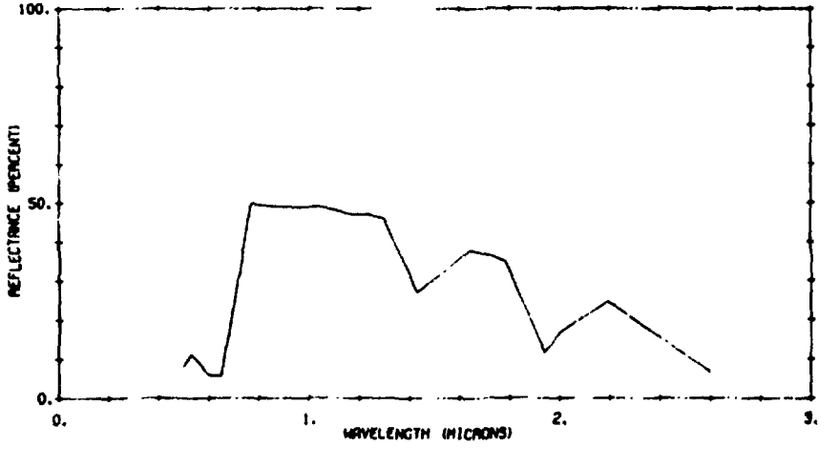
B09007 260

TREE 6, LEAF 2, NO WATER SINCE 1 MAY



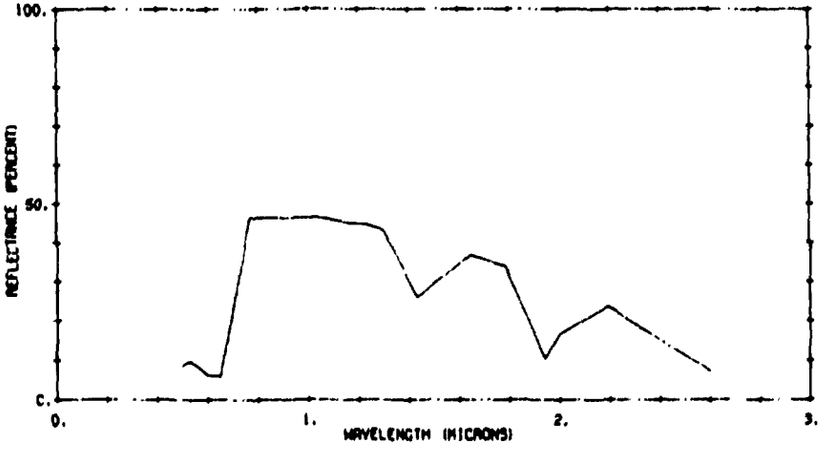
809007 261

TREE 6, LEAF 3 NO WATER SINCE 1 MAY



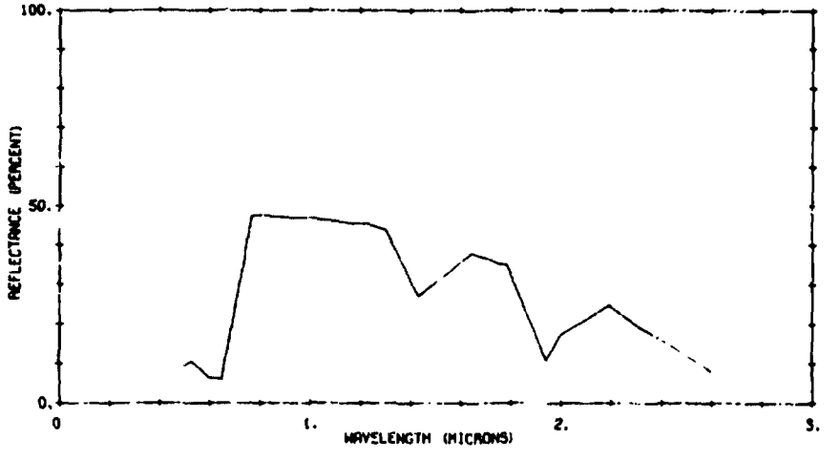
809007 262

TREE 6, LEAF 1 NO WATER SINCE 1 MAY



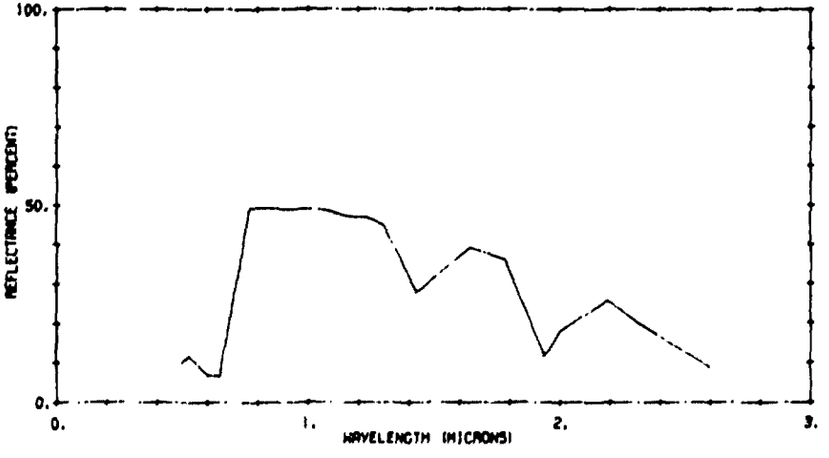
809007 263

TREE 6, LEAF 2. NO WATER SINCE 1 MAY



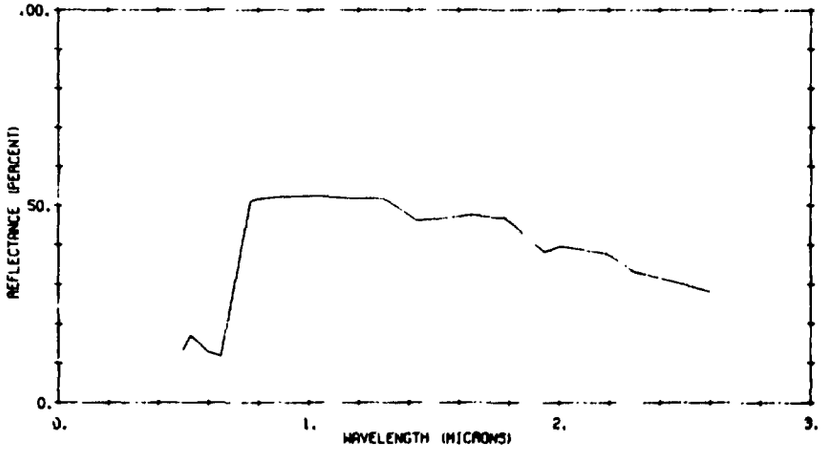
809007 264

TREE 6, LEAF 3. NO WATER SINCE 1 MAY



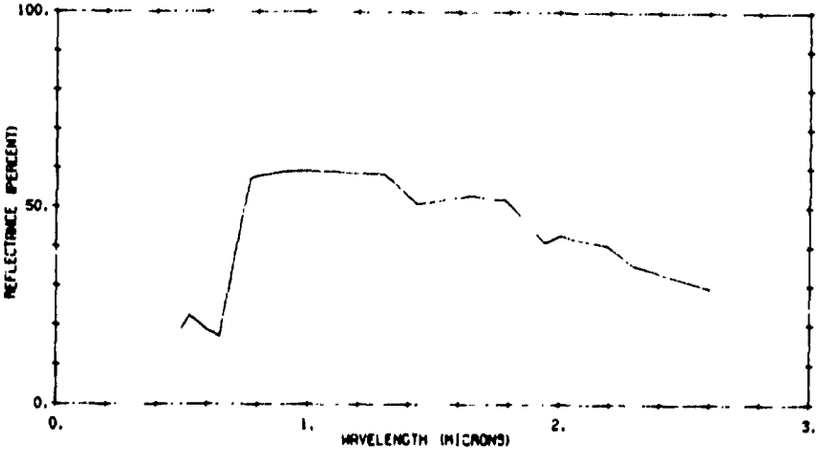
809007 265

TREE 6, LEAF 1 NO WATER SINCE 1 MAY LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM BROWN PORTION ONLY



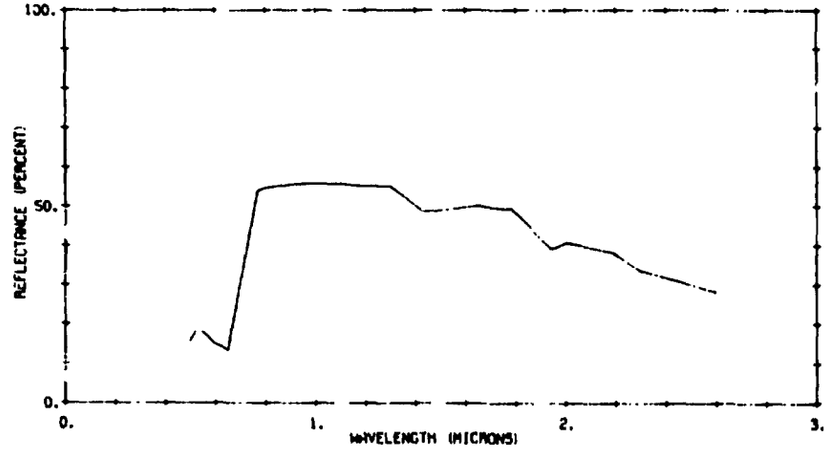
809007 266

TREE 6, LEAF 2 NO WATER SINCE 1 MAY LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM BROWN PORTION ONLY



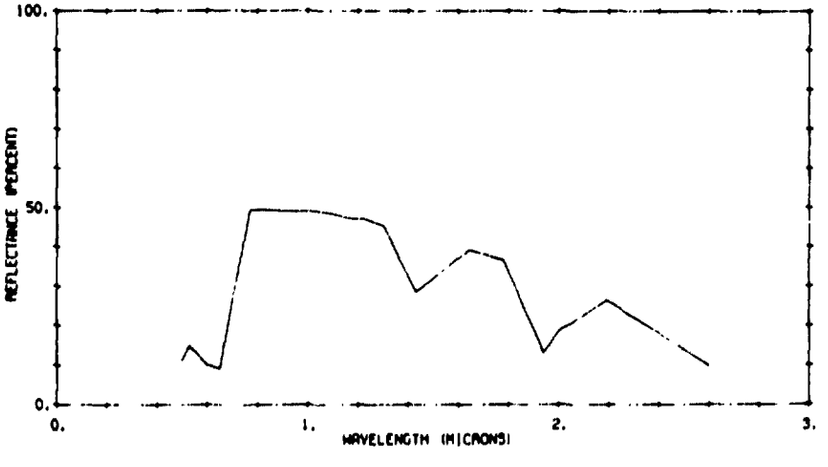
809007 267

TREE 6, LEAF 3 NO WATER SINCE 1 MAY LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN. CURVE FROM BROWN PORTION ONLY



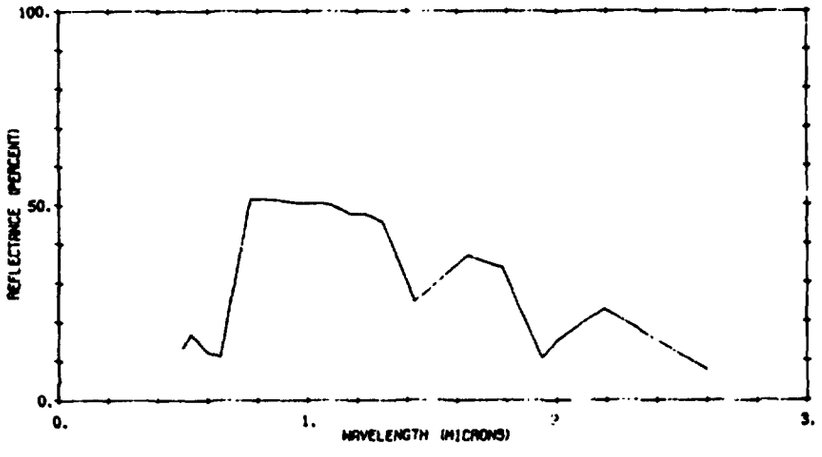
809007 268

TREE 6, LEAF 4 NO WATER SINCE 1 MAY LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM BROWN PORTION ONLY



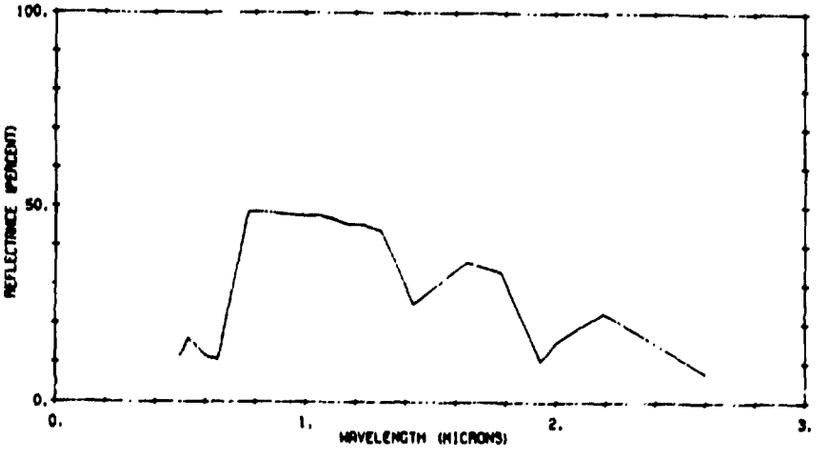
B09007 269

TREE 6, LEAF 2 NO WATER SINCE 1 MAY. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM GREEN PORTION ONLY.



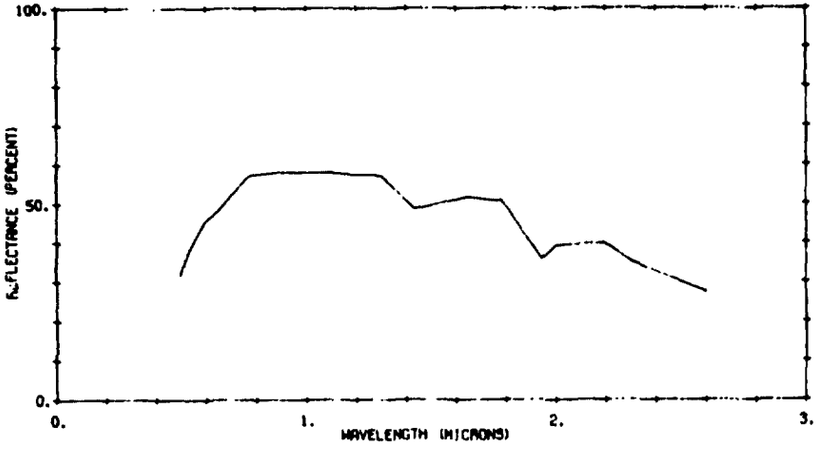
B09007 270

TREE 6, LEAF 3. NO WATER SINCE 1 MAY. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM GREEN PORTION ONLY



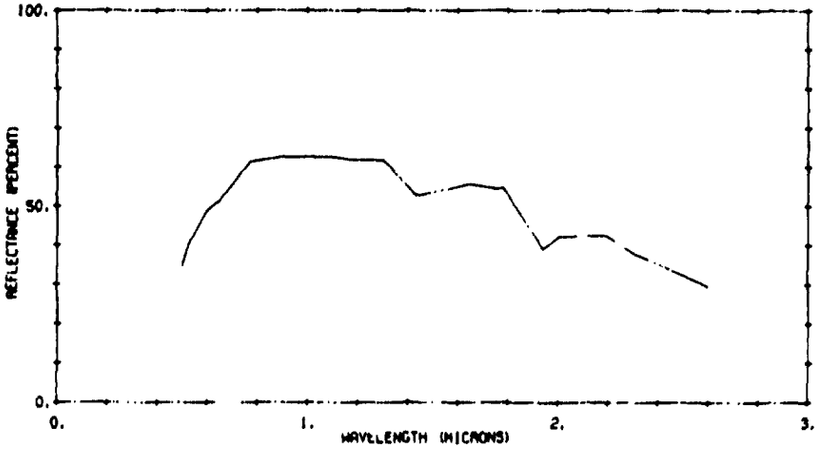
B09007 271

TREE 6, LEAF 1. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM BROWN PORTION ONLY.



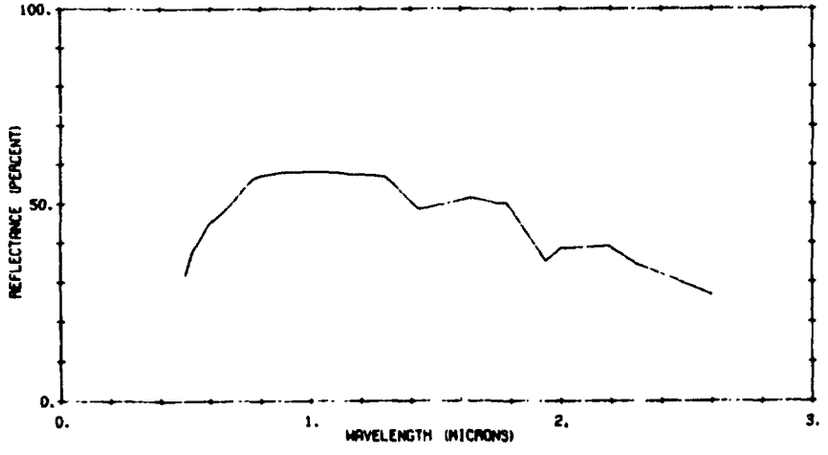
B09007 272

TREE 6, LEAF 2. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM BROWN PORTION ONLY



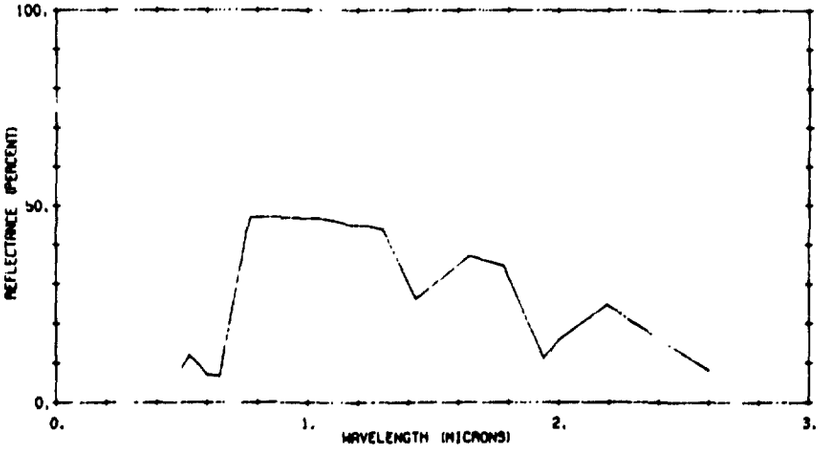
B09007 273

TREE 6, LEAF 3 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM BROWN PORTION ONLY



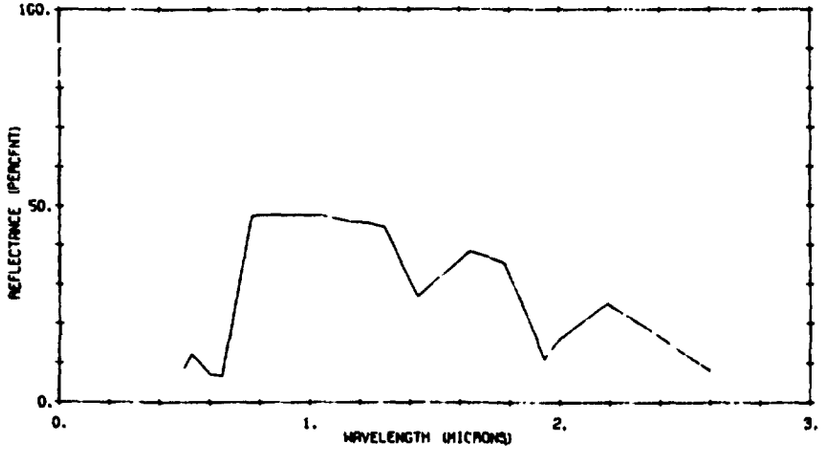
B09007 274

TREE 6, LEAF 1. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN. CURVE FROM GREEN PORTION ONLY



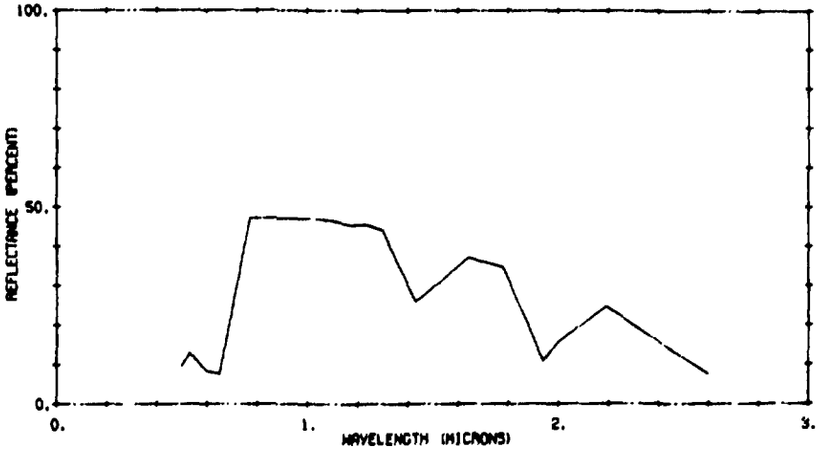
B09007 275

TREE 6, LEAF 2. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN. CURVE FROM GREEN PORTION ONLY

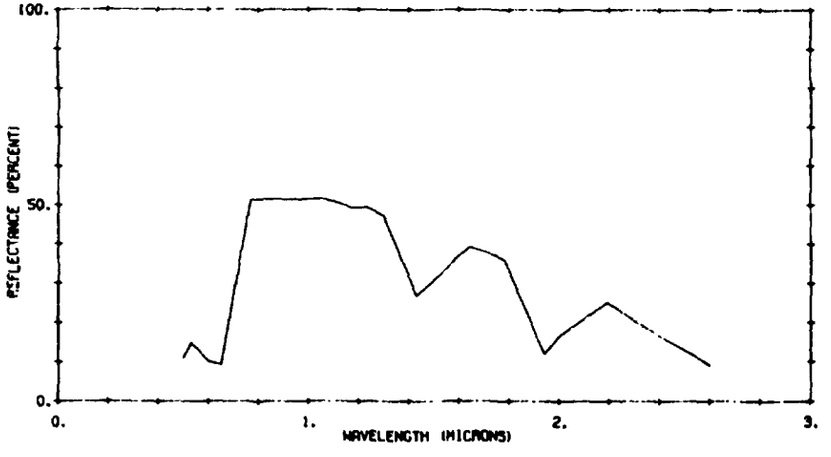


B09007 276

TREE 6, LEAF 3 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM GREEN PORTION ONLY

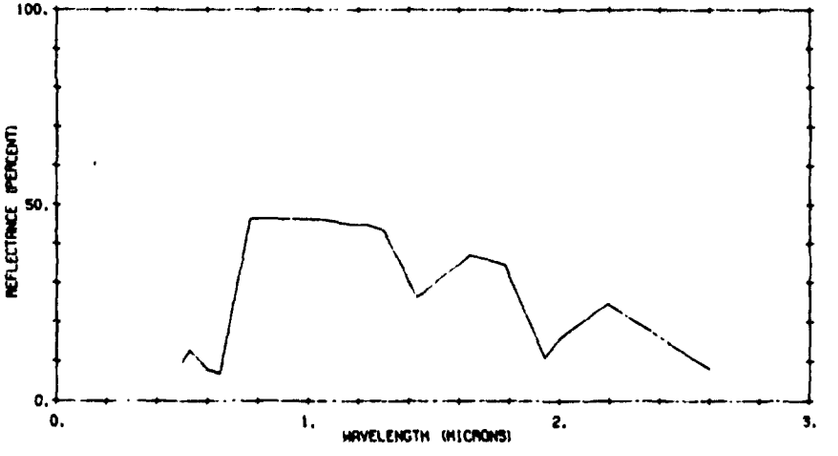


LEAF [illegible] MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND
[illegible] DAY [illegible] LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN
[illegible] PORTION ONLY



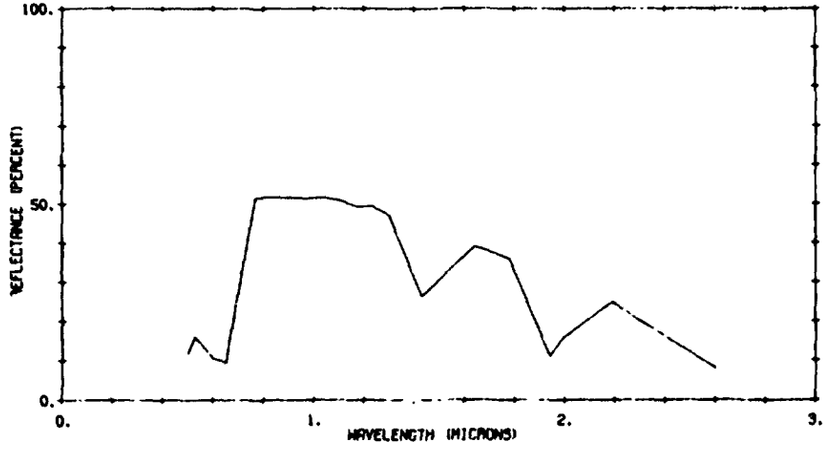
B09007 278

TREE 6, LEAF 2. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM GREEN PORTION ONLY.



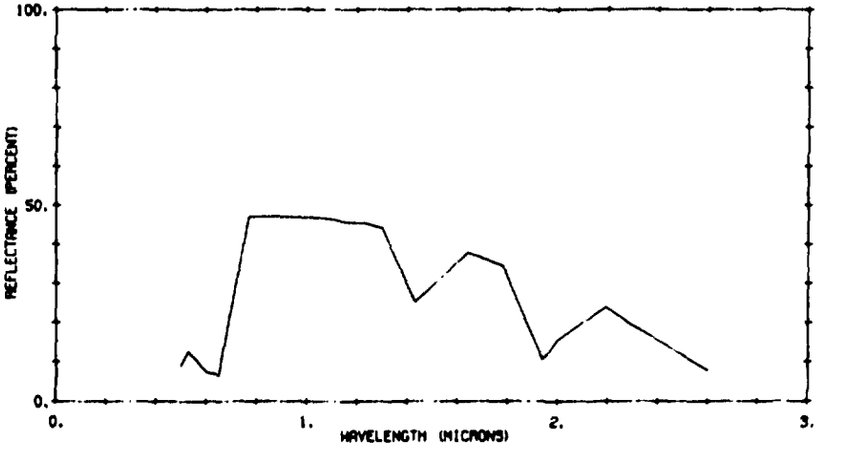
B09007 279

TREE 6, LEAF 3. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM GREEN PORTION ONLY



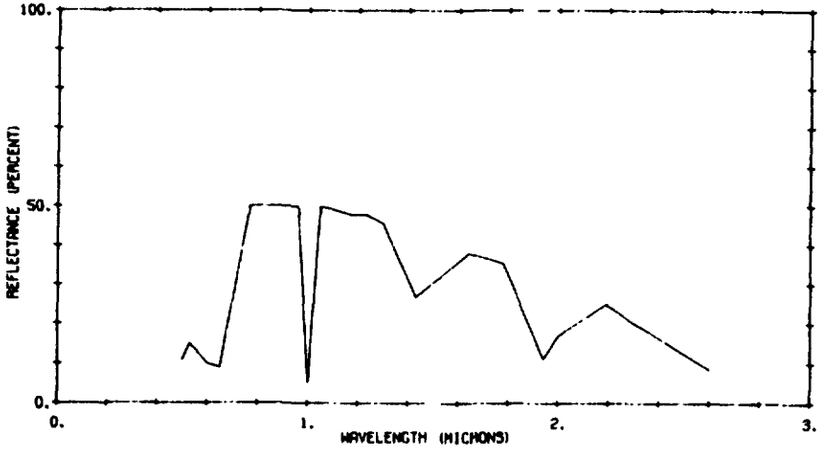
B09007 280

TREE 6, LEAF 1. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN. CURVE FROM GREEN PORTION ONLY.



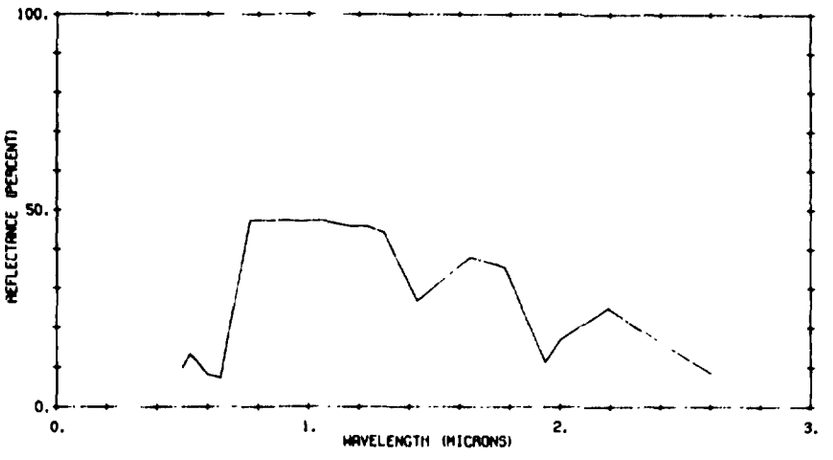
B09007 281

TREE 6, LEAF 2. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN CURVE FROM GREEN PORTION ONLY



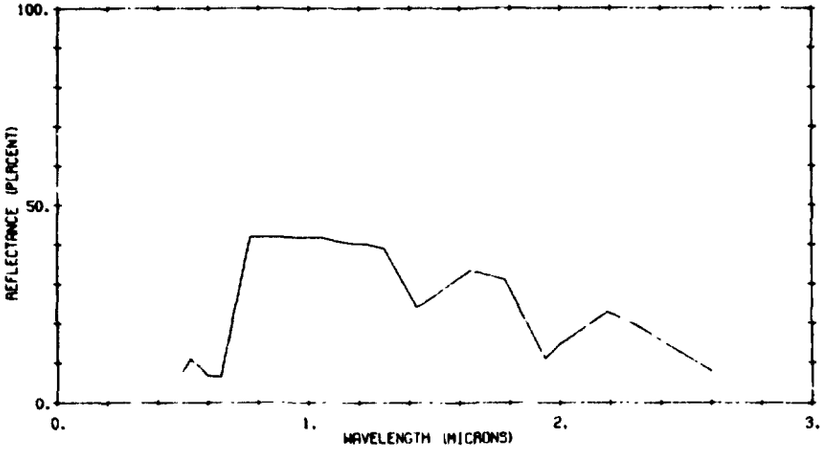
B09007 282

TREE 6, LEAF 3 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVEI / SECOND OR THIRD DAY THEREAFTER LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN. CURVE FROM GREEN PORTION ONLY



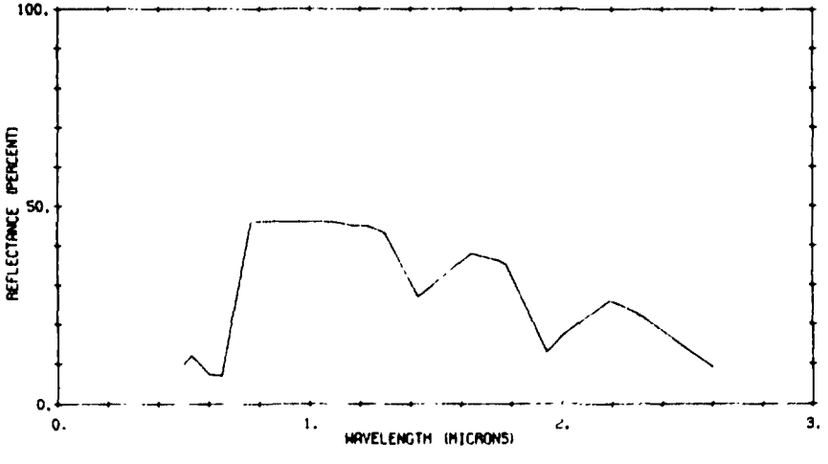
B09007 283

TREE 7, LEAF 1 NO WATER SINCE 1 MAY



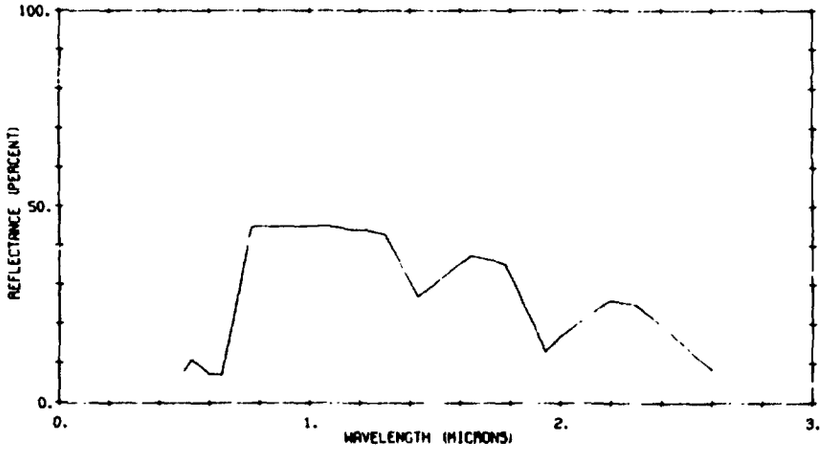
B09007 284

TREE 7, LEAF 2 NO WATER SINCE 1 MAY



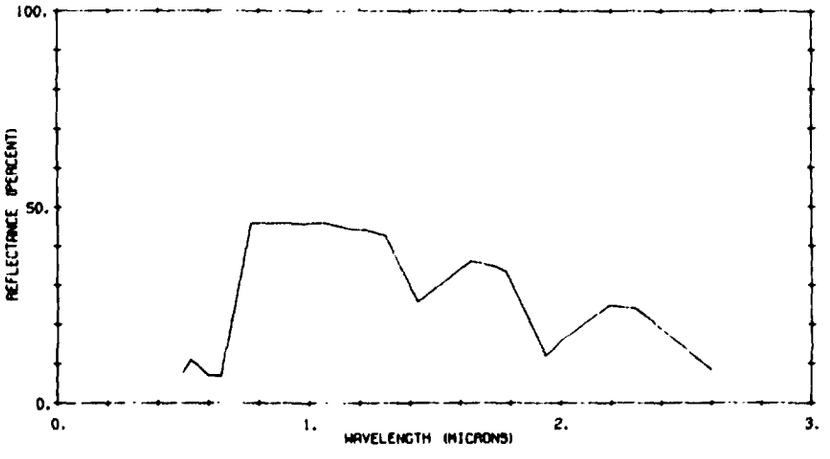
B09007 285

TREE 7, LEAF 1 NO WATER SINCE 1 MAY



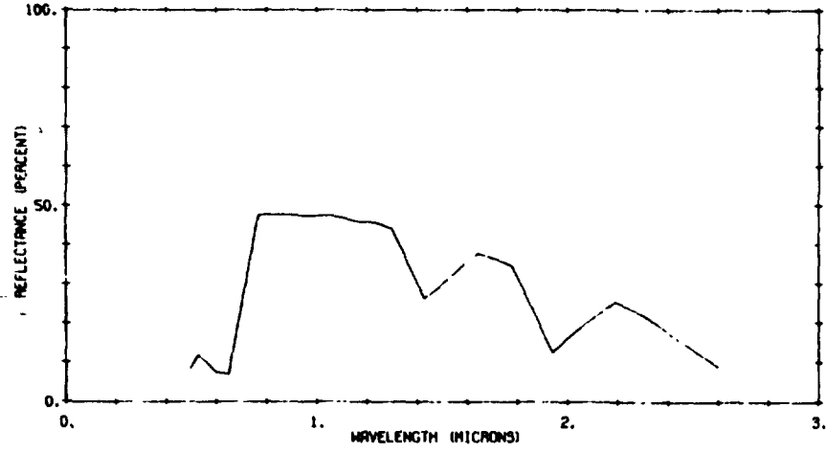
B09007 286

TREE 7, LEAF 2. NO WATER SINCE 1 MAY.



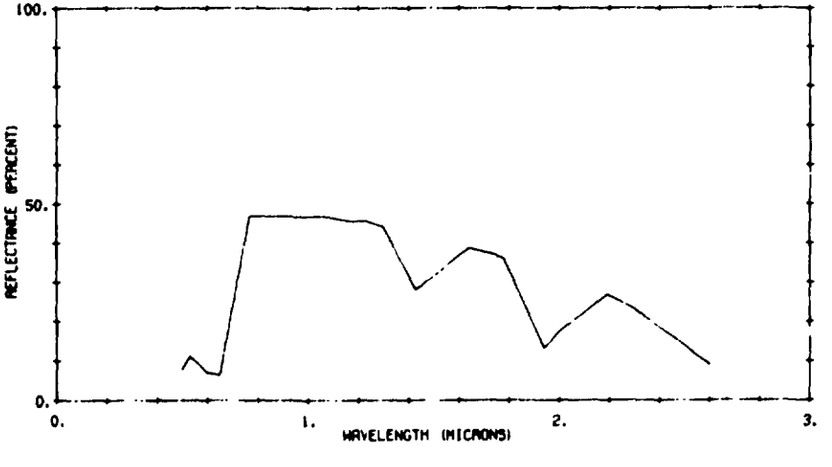
B09007 287

TREE 7, LEAF 3. NO WATER SINCE 1 MAY



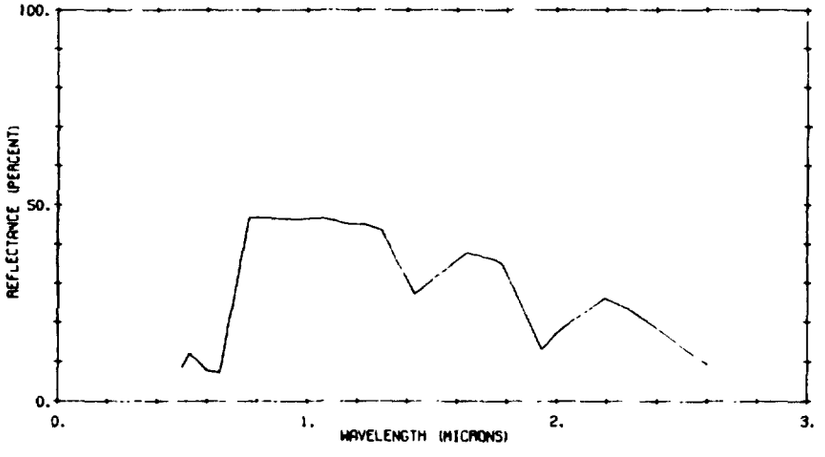
B09007 288

TREE 7, LEAF 4. NO WATER SINCE 1 MAY.



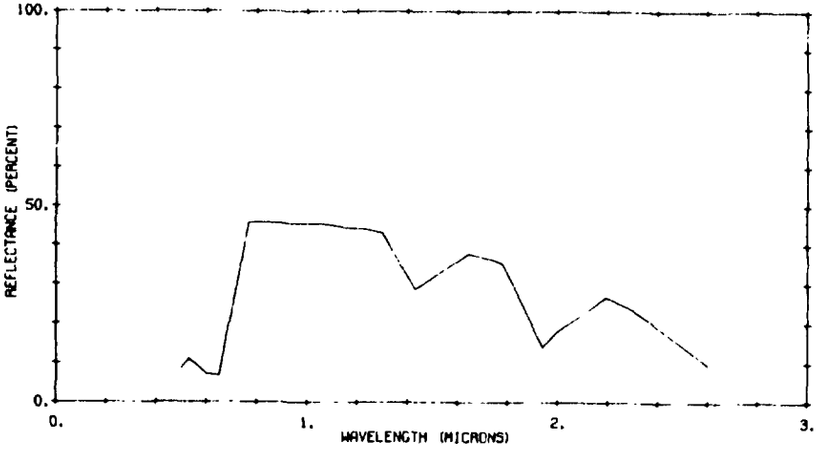
809007 289

TREE 7, LEAF 3 NO WATER SINCE 1 MAY LEAF UNFOLDED UNDER MOISTURE STRESS.



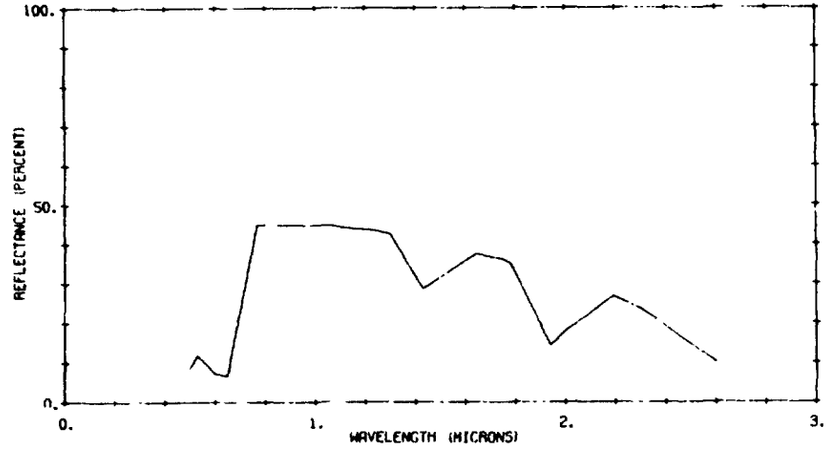
809007 290

TREE 7 LEAF 1 NO WATER SINCE 1 MAY.



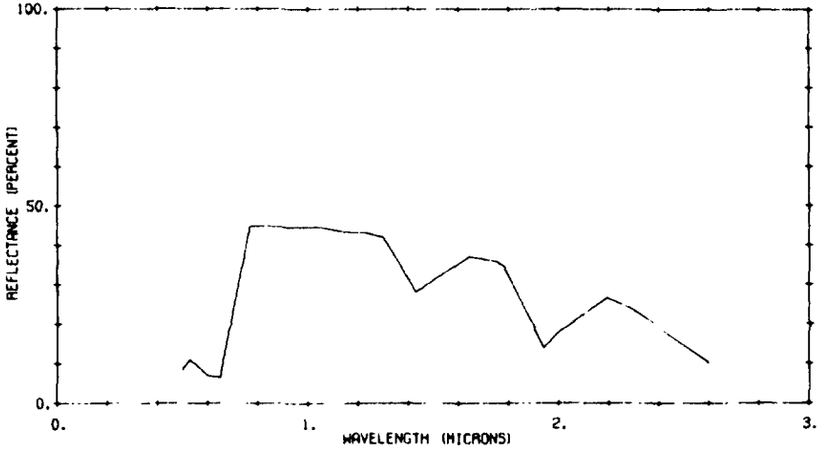
809007 291

TREE 7, LEAF 2. NO WATER SINCE 1 MAY



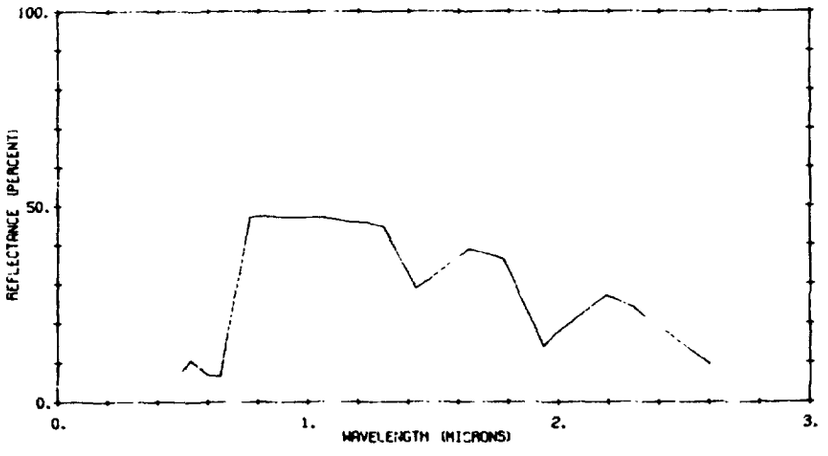
809007 292

TREE 7, LEAF 3. NO WATER SINCE 1 MAY LEAF UNFOLDED UNDER MOISTURE STRESS



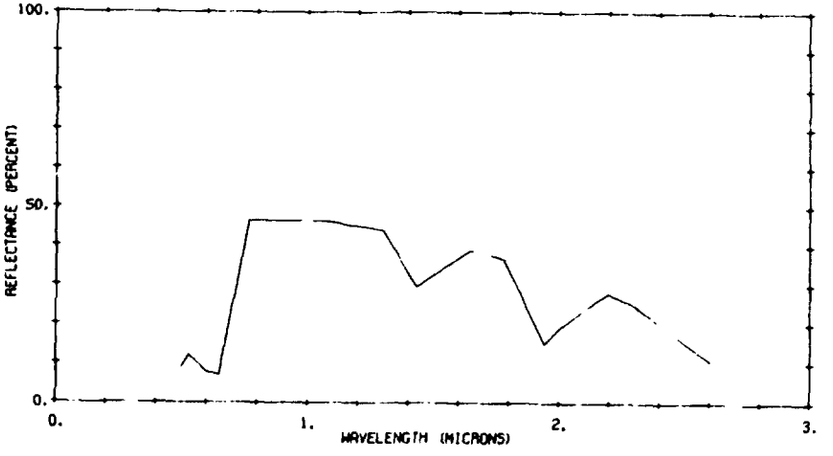
B09007 293

TREE 7, LEAF 1. NO WATER SINCE 1 MAY.



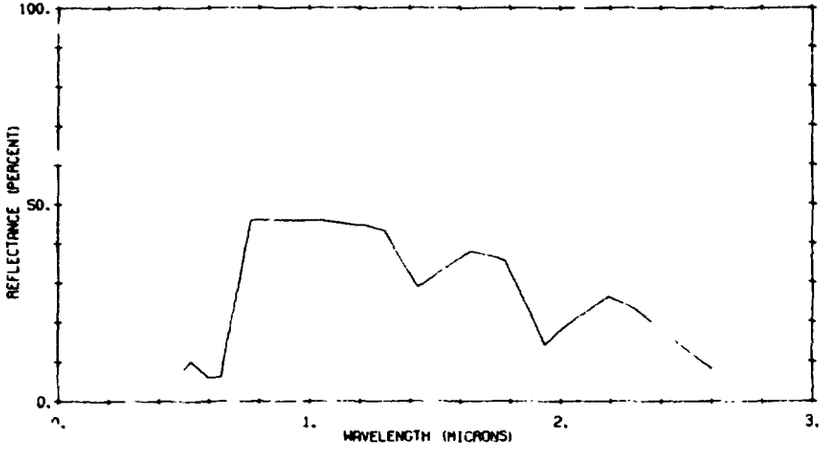
B09007 295

TREE 7, LEAF 3. NO WATER SINCE 1 MAY LEAF UNFOLDED UNDER MOISTURE STRESS



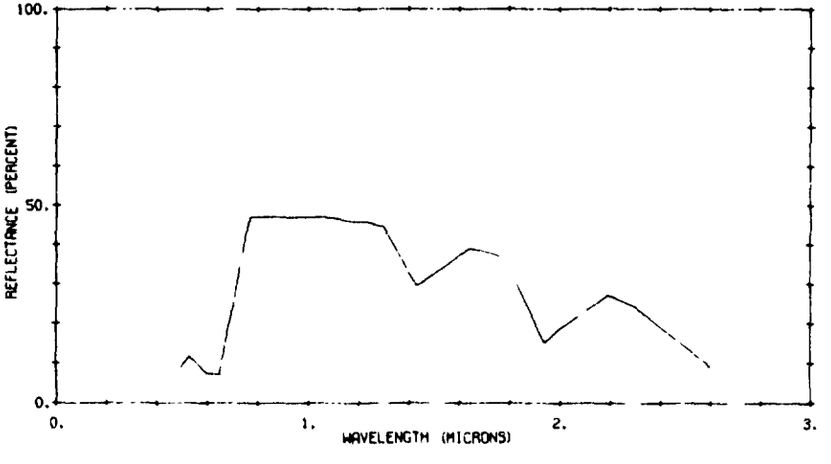
B09007 296

TREE 7, LEAF 1. NO WATER SINCE 1 MAY



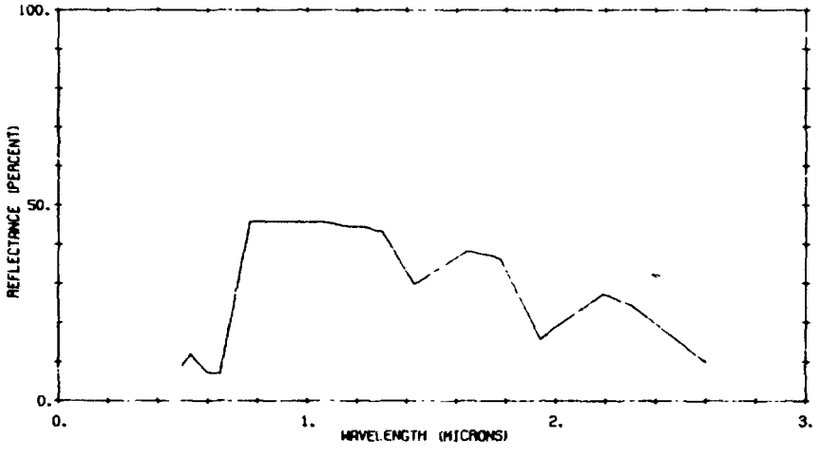
B09007 297

TREE 7, LEAF 2. NO WATER SINCE 1 MAY.



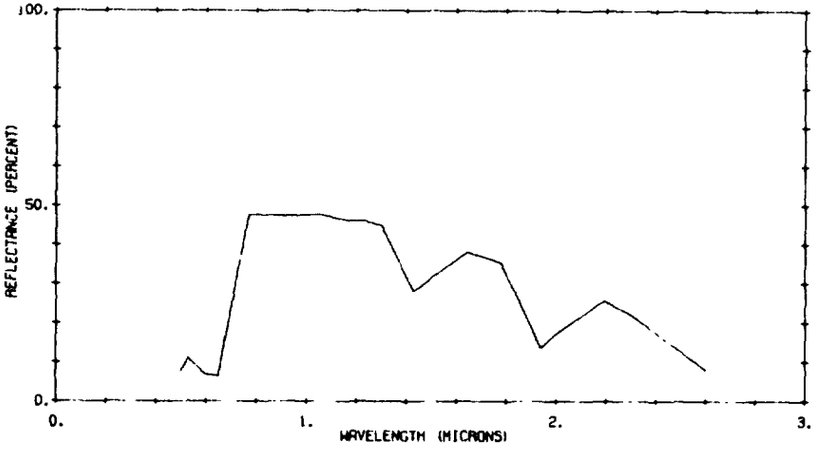
B09007 298

TREE 7, LEAF 3. NO WATER SINCE 1 MAY. LEAF UNFOLDED UNDER MOIS.URE STRESS.



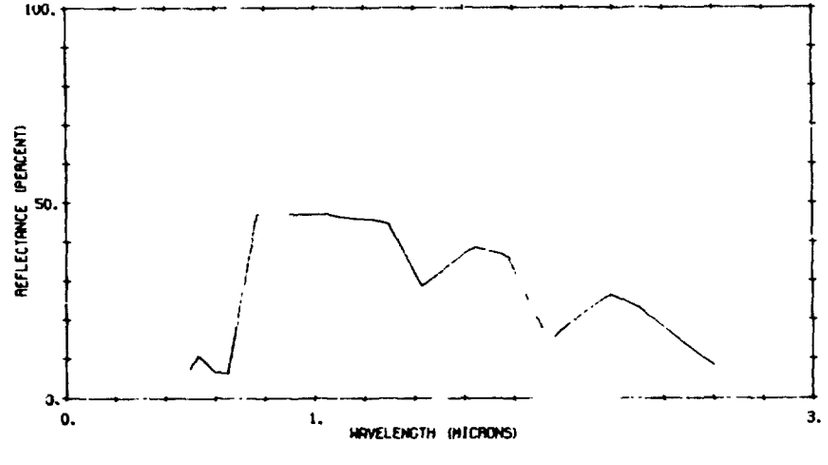
B09007 299

TREE 7, LEAF 1. NO WATER SINCE 1 MAY



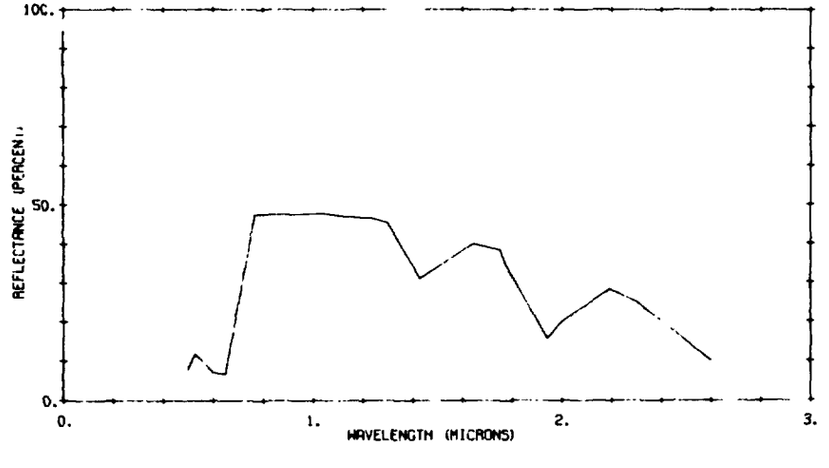
B09007 300

TREE 7, LEAF 2. NO WATER SINCE 1 MAY.



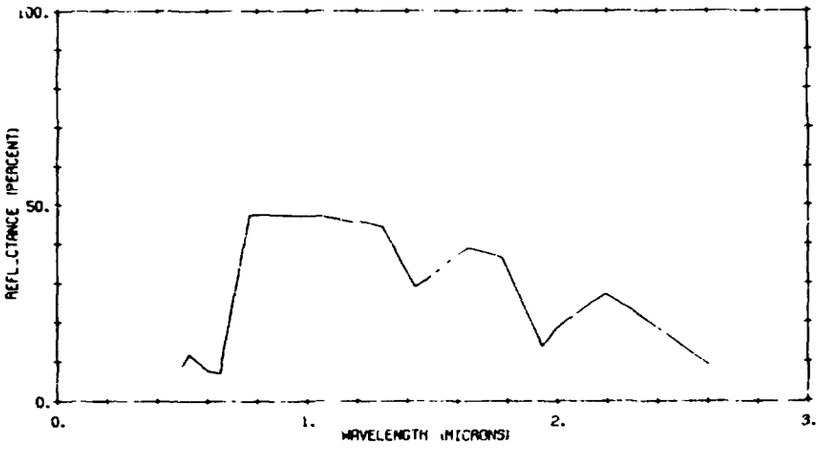
B09007 301

TREE 7, LEAF 3. NO WATER SINCE 1 MAY. LEAF UNFOLDED UNDER MOISTURE STRESS.



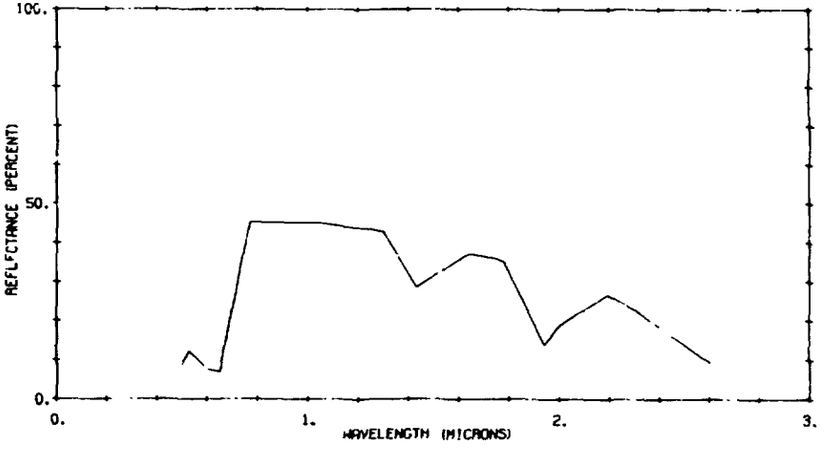
B09007 302

TREE 7, LEAF 1. NO WATER SINCE 1 MAY



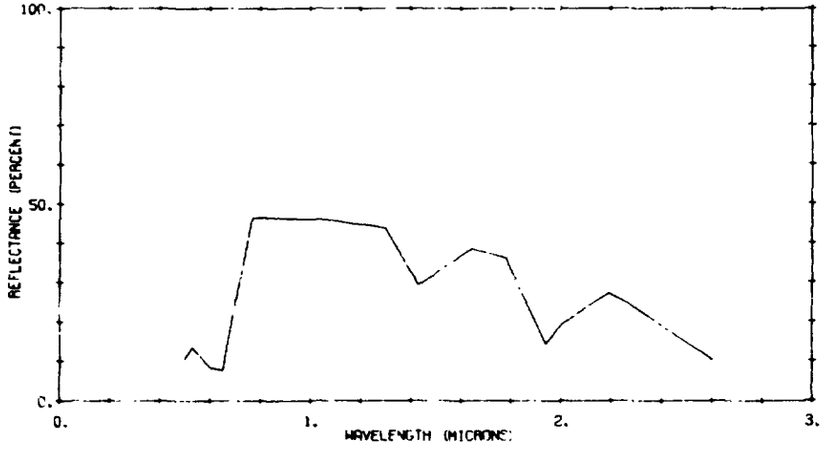
B09007 303

TREE 7, LEAF 2. NO WATER SINCE 1 MAY



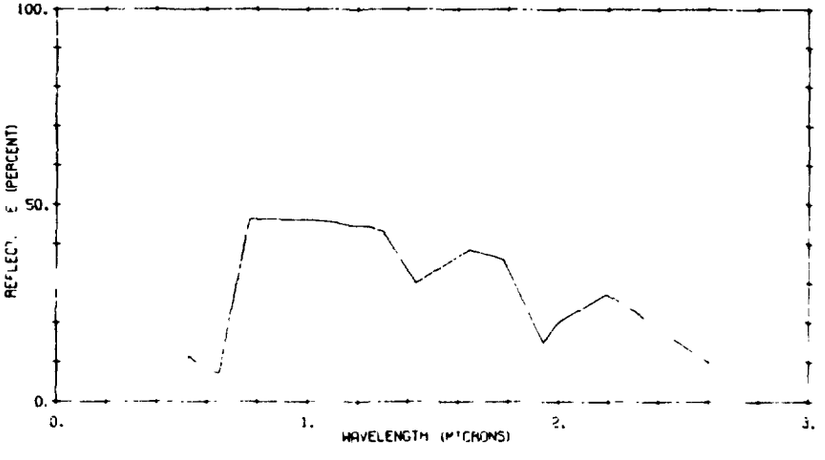
B09007 304

TREE 7, LEAF 3. NO WATER SINCE 1 MAY LEAF UNFOLDED UNDER MOISTURE STRESS.



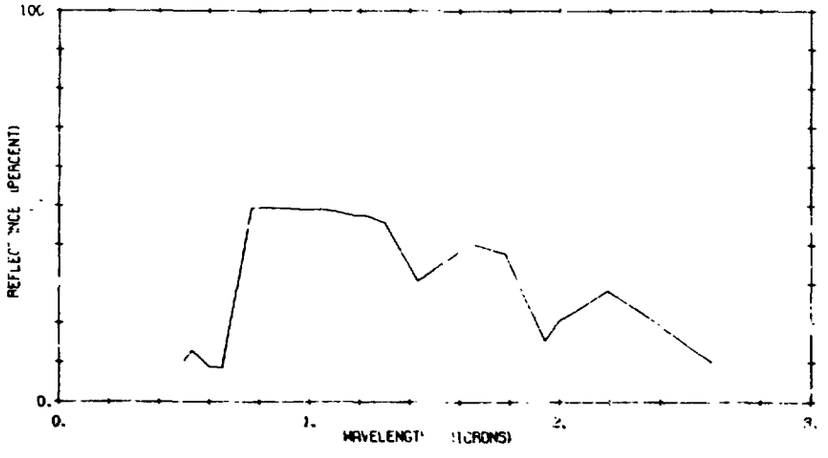
B09007 305

TREE 7, LEAF 1. NO WATER SINCE 1 MAY. BROWN (DEAD) SPOTS ON LEAF.



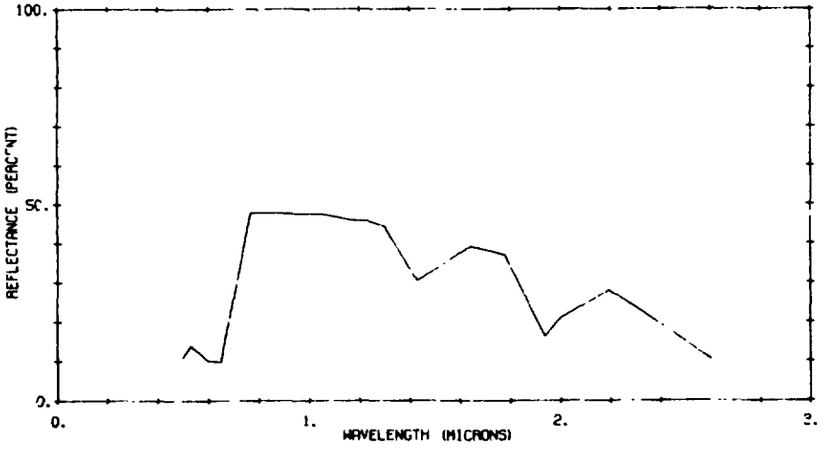
B09007 306

TREE 7 LEAF 2. NO WATER SINCE 1 MAY. BROWN (DEAD) SPOTS ON LEAF.



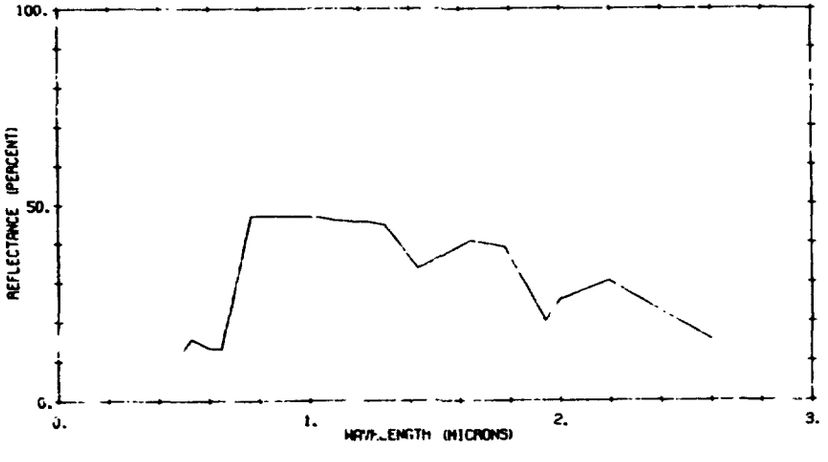
B09007 307

TREE 7 LEAF 3 NO WATER SINCE 1 MAY. LEAF UNFOLDED UNDER MOISTURE STRESS. BROWN (DEAD) SPOTS ON LEAF.



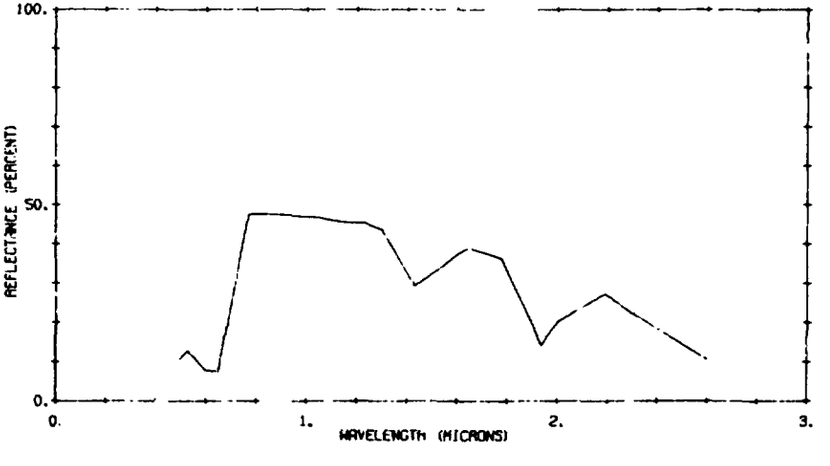
B09007 308

TREE 7, LEAF 1. NO WATER SINCE 1 MAY BROWN (DEAD) SPOTS ON LEAF.



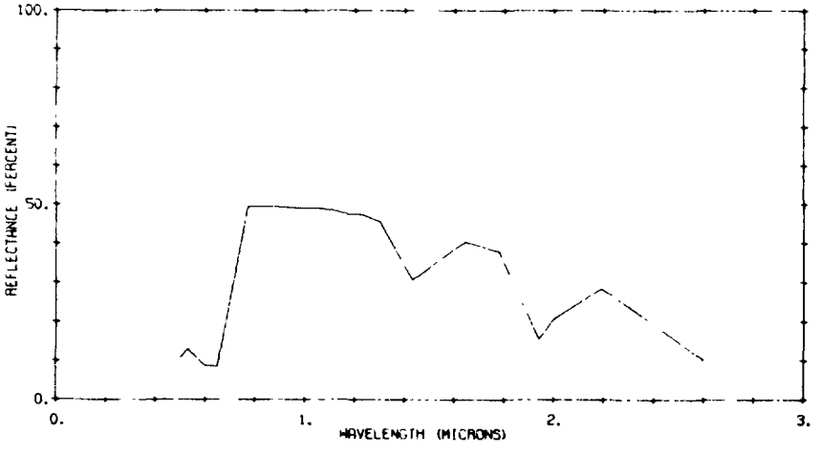
B09007 309

TREE 7, LEAF 2. NO WATER SINCE MAY. BROWN (DEAD) SPOTS ON LEAF.



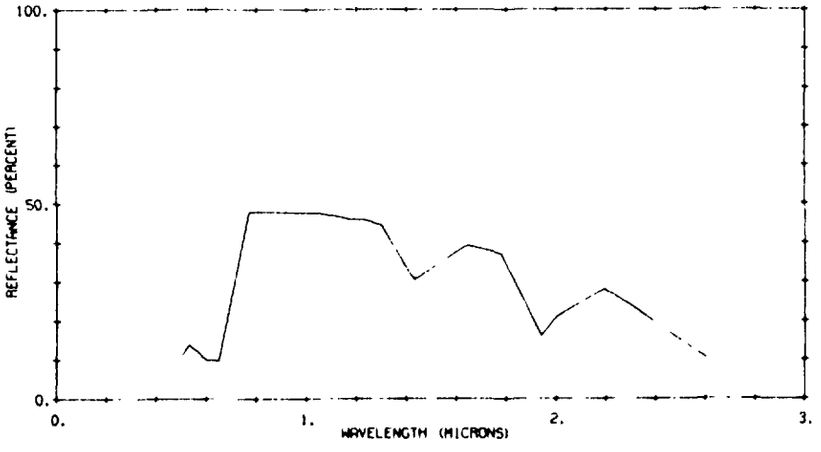
B09007 306

TREE 7, LEAF 2 NO WATER SINCE 1 MAY. BROWN (DEAD) SPOTS ON LEAF



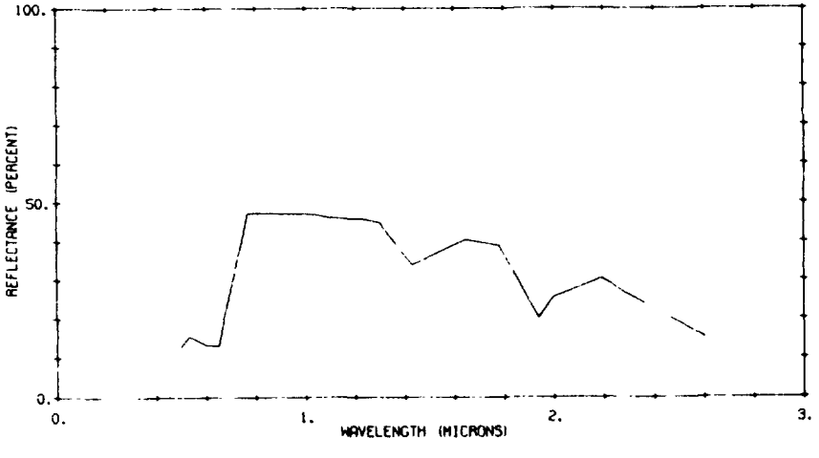
B09007 307

TREE 7, LEAF 3. NO WATER SINCE 1 MAY. LEAF UNFOLDED UNDER MOISTURE STRESS BROWN (DEAD) SPOTS ON LEAF



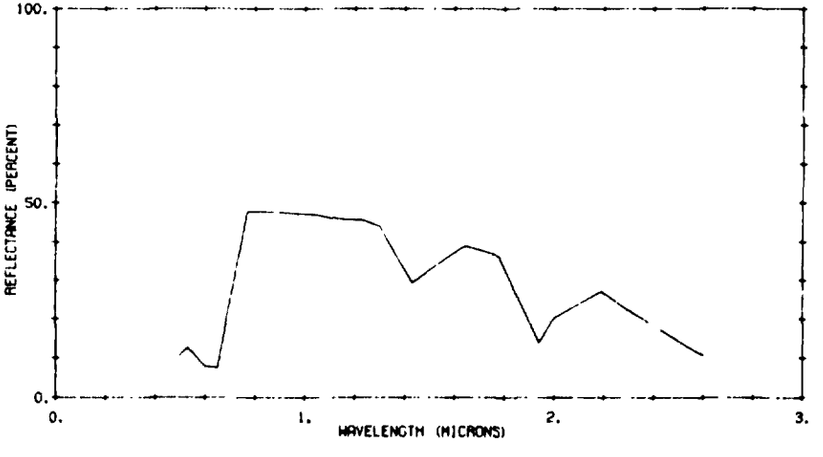
B09007 308

TREE 7, LEAF 1 NO WATER SINCE 1 MAY. BROWN (DEAD) SPOTS ON LEAF



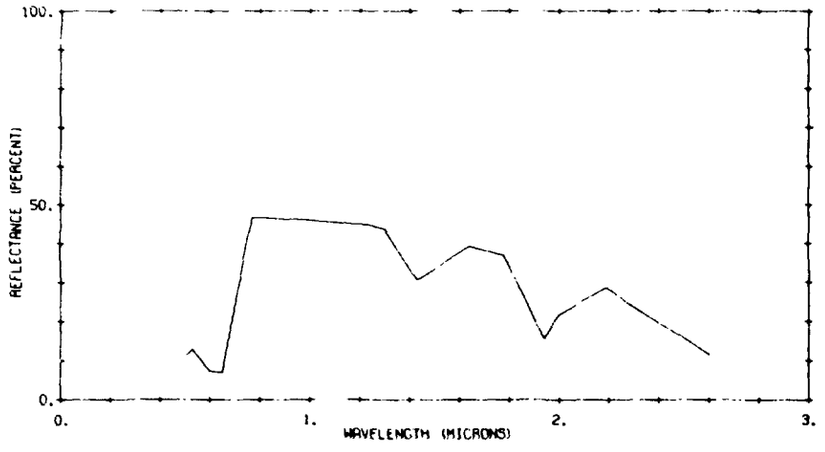
B09007 309

TREE 7, LEAF 2 NO WATER SINCE 1 MAY. BROWN (DEAD) SPOTS ON LEAF



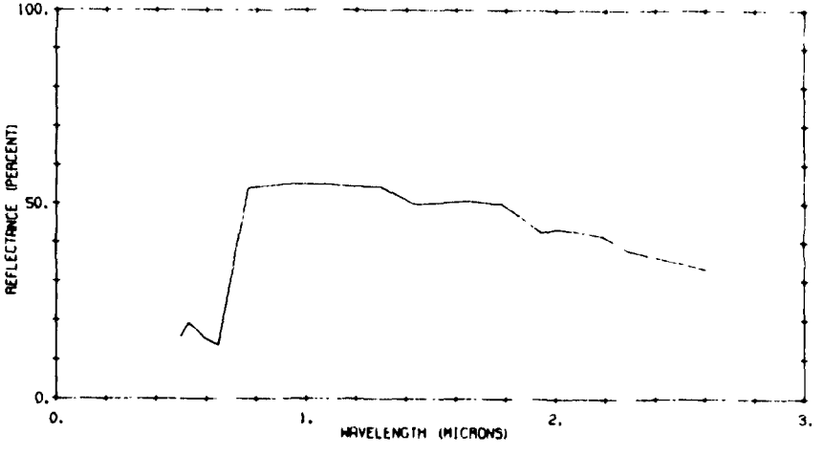
B09007 310

TREE 7 LEAF 3 NO WATER SINCE 1 MAY LEAF UNFOLDED UNDER MOISTURE STRESS BROWN (DEAD) SPOTS ON LEAF



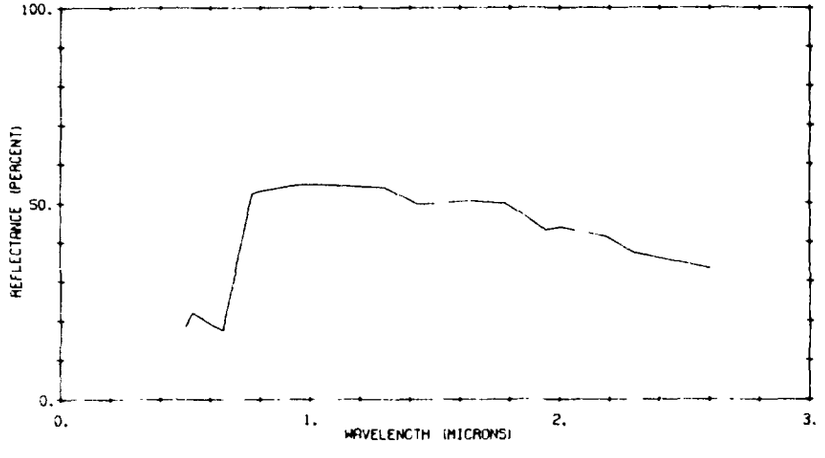
B09007 311

TREE 7, LEAF 1 NO WATER SINCE 1 MAY BROWN (DEAD) SPOTS ON LEAF



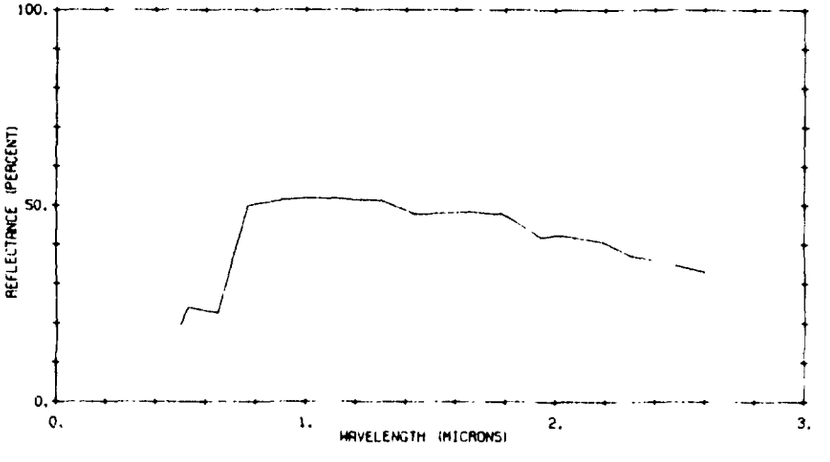
B09007 312

TREE 7 LEAF 2 NO WATER SINCE 1 MAY BROWN (DEAD) SPOTS ON LEAF



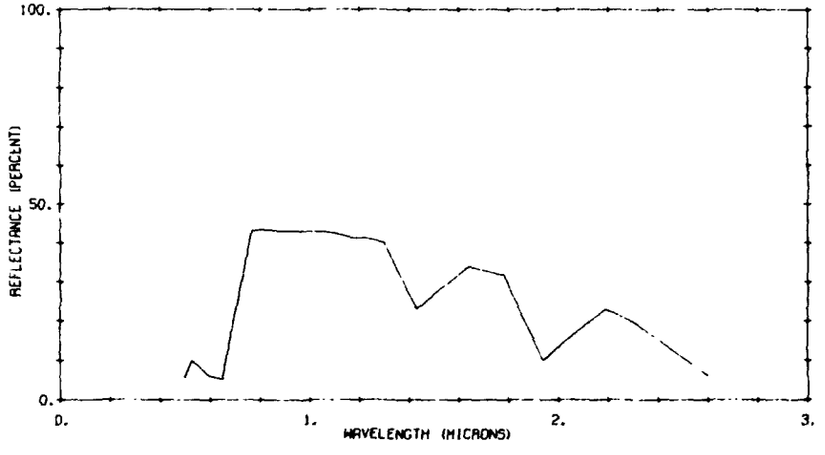
B09007 313

TREE 7, LEAF 3. NO WATER SINCE 1 MAY. LEAF UNFOLDED UNDER MOISTURE STRESS. BROWN (DEAD) SPOTS ON LEAF.



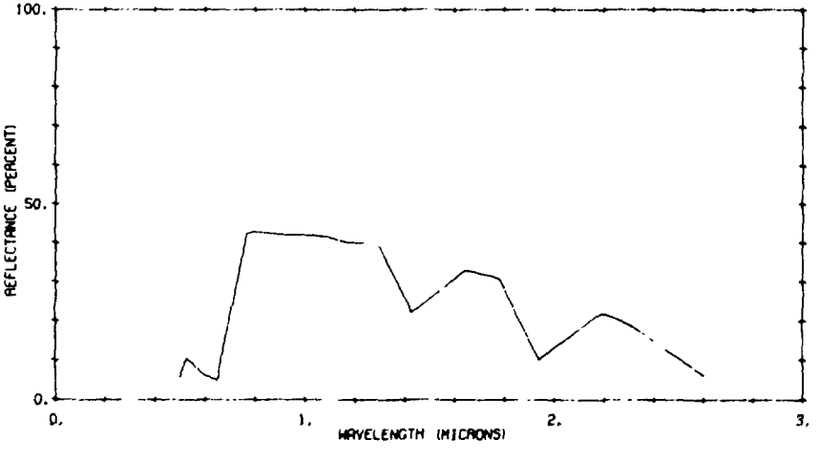
B09007 314

TREE 8 LEAF 1 NO WATER SINCE 1 MAY.



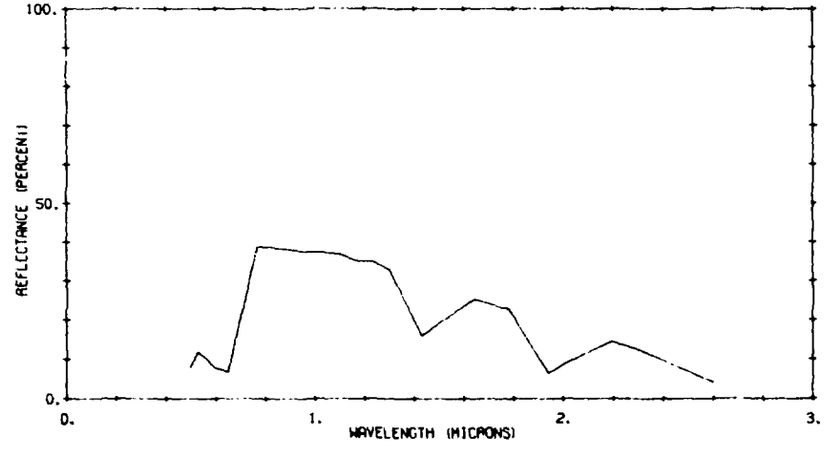
B09007 315

TREE 8 LEAF 2. NO WATER SINCE 1 MAY



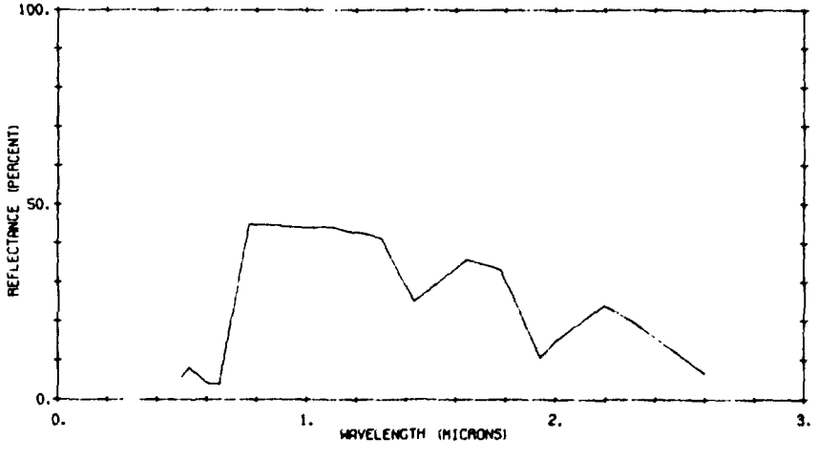
B09007 316

TREE 8. LEAF 3 NO WATER SINCE 1 MAY



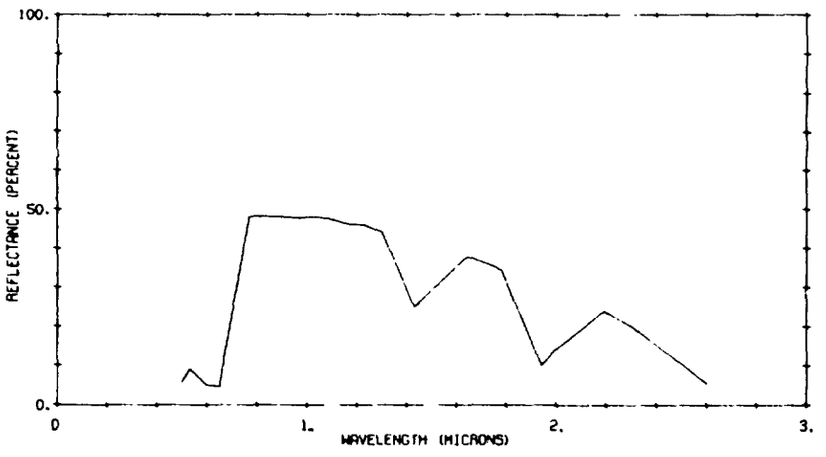
B09007 317

TREE 8. LEAF 1. NO WATER SINCE 1 MAY



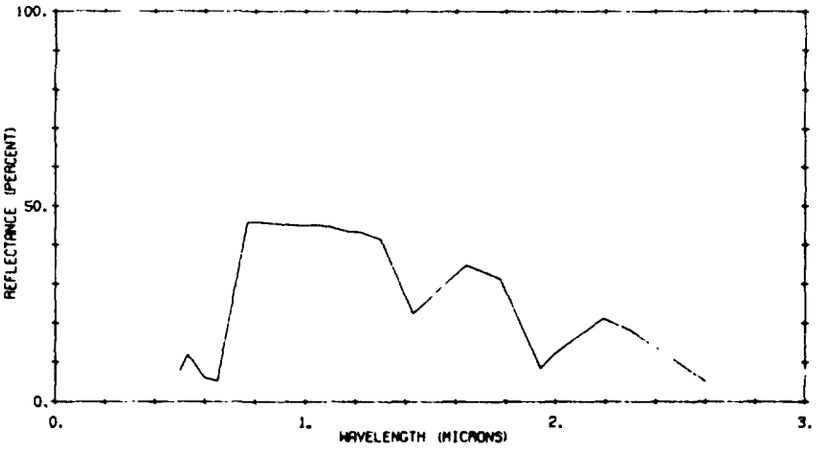
B09007 318

TREE 8, LEAF 2. NO WATER SINCE 1 MAY



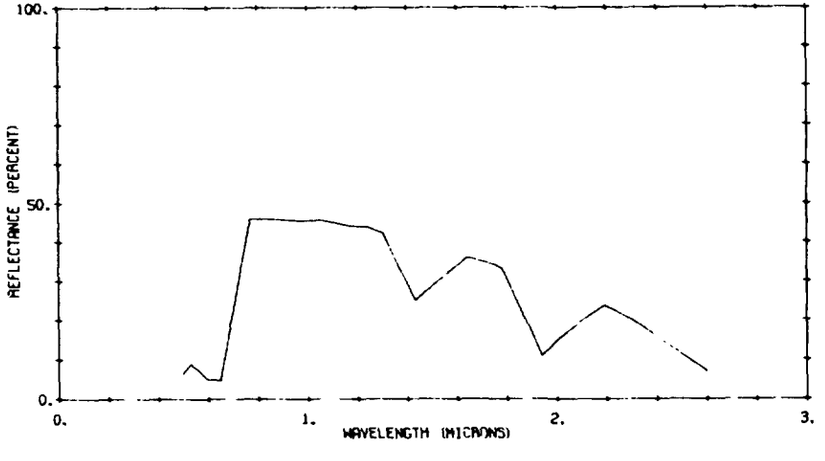
B09007 319

TREE 8, LEAF 3 NO WATER SINCE 1 MAY



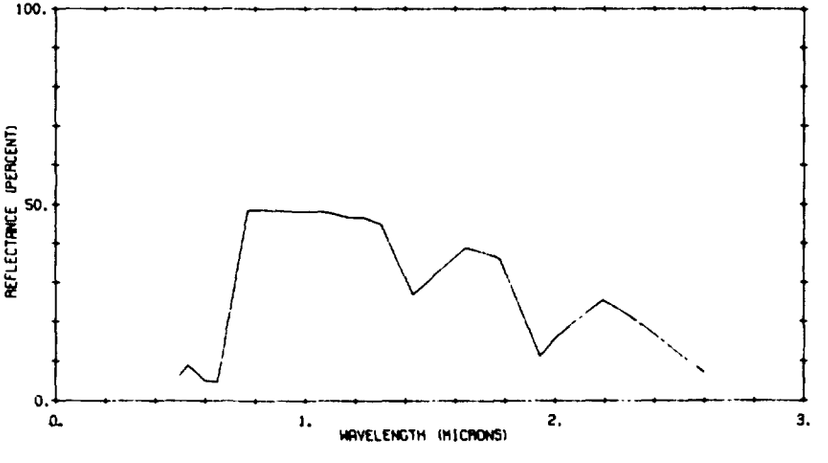
B09007 320

TREE 8, LEAF 1. NO WATER SINCE 1 MAY



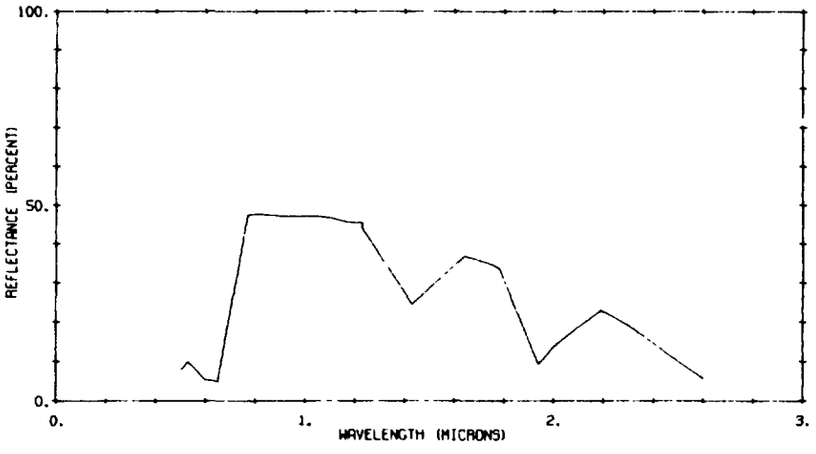
B09007 321

TREE 8, LEAF 2. NO WATER SINCE 1 MAY



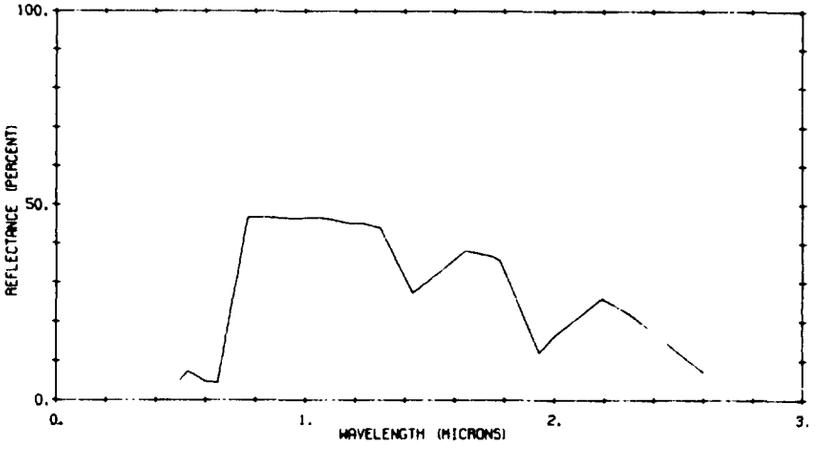
B09007 322

TREE 8, LEAF 3 NO WATER SINCE 1 MAY



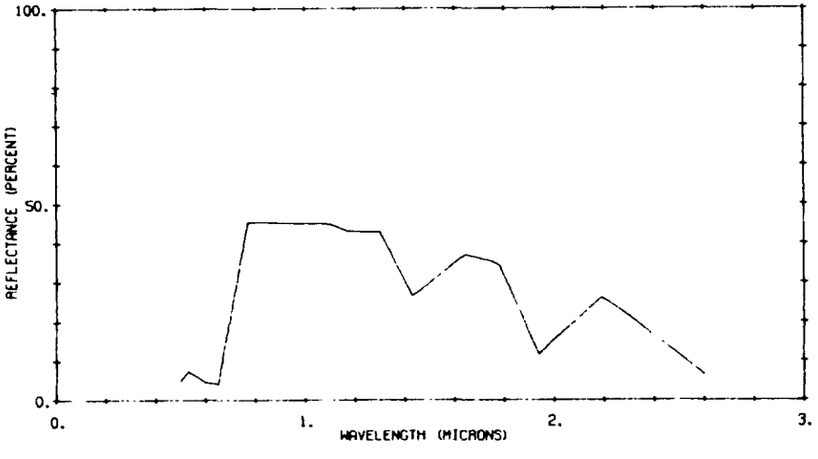
B09007 323

TREE 8, LEAF 4 NO WATER SINCE 1 MAY



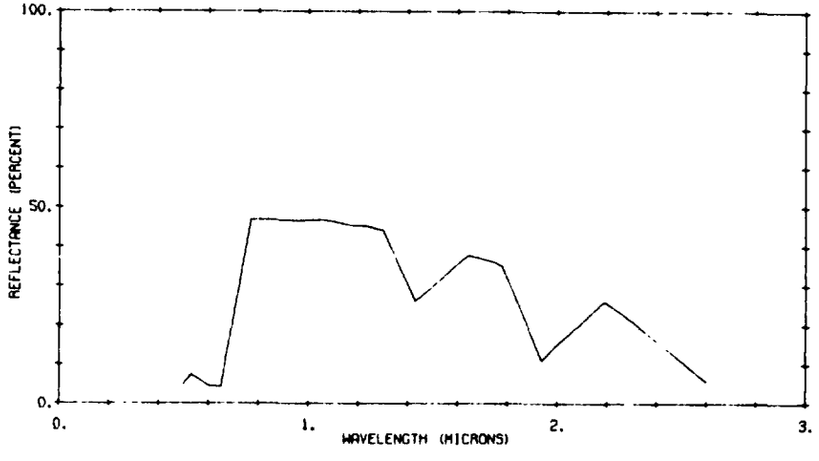
B09007 324

TREE 8, LEAF 5. NO WATER SINCE 1 MAY



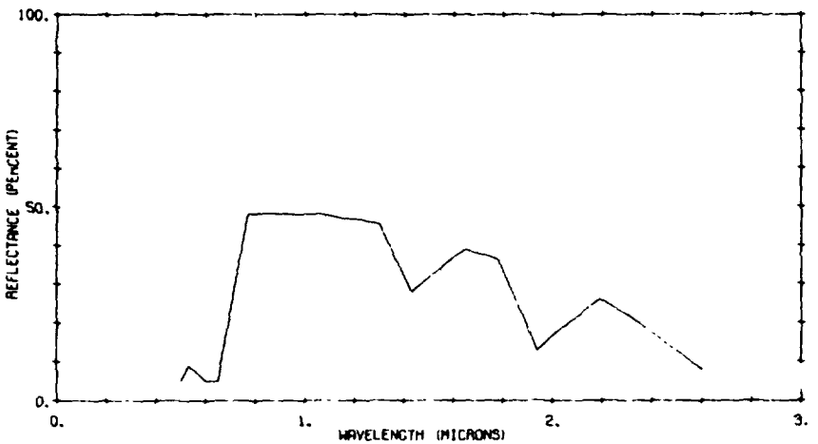
B09007 325

TREE 8, LEAF 6. NO WATER SINCE 1 MAY.



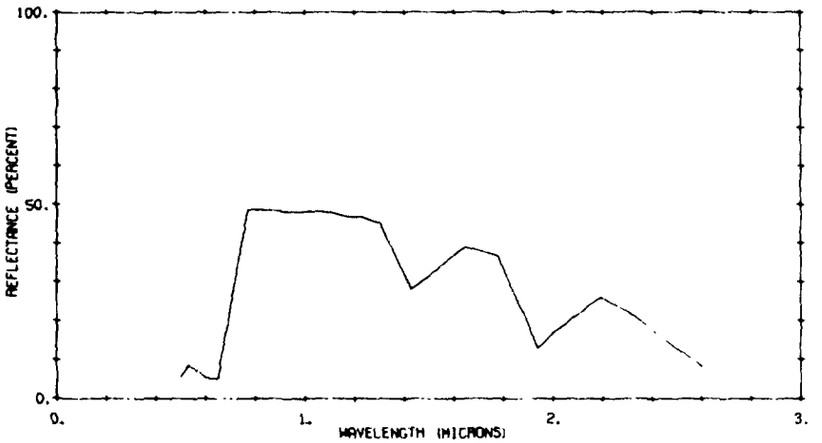
B09007 326

TREE 8, LEAF 4. NO WATER SINCE 1 MAY



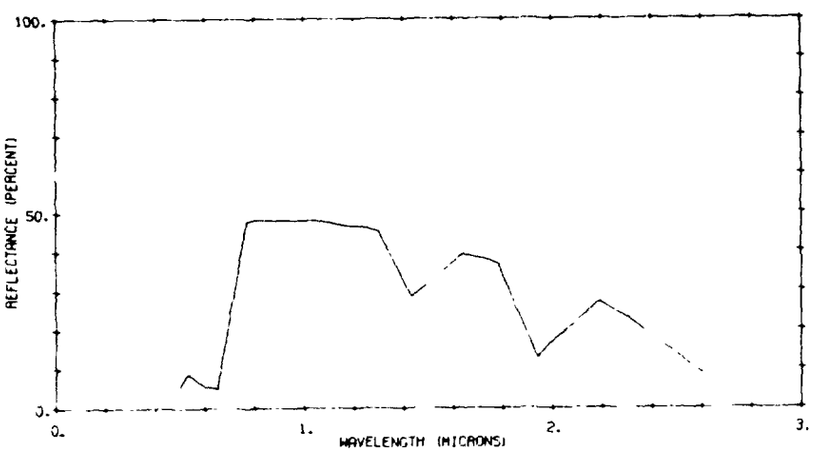
B09007 327

TREE 8, LEAF 5. NO WATER SINCE 1 MAY



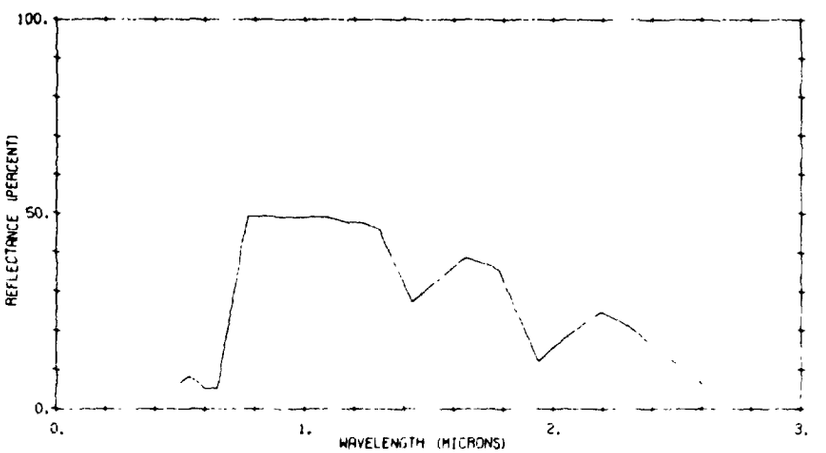
B09007 328

TREE 8, LEAF 6. NO WATER SINCE 1 MAY



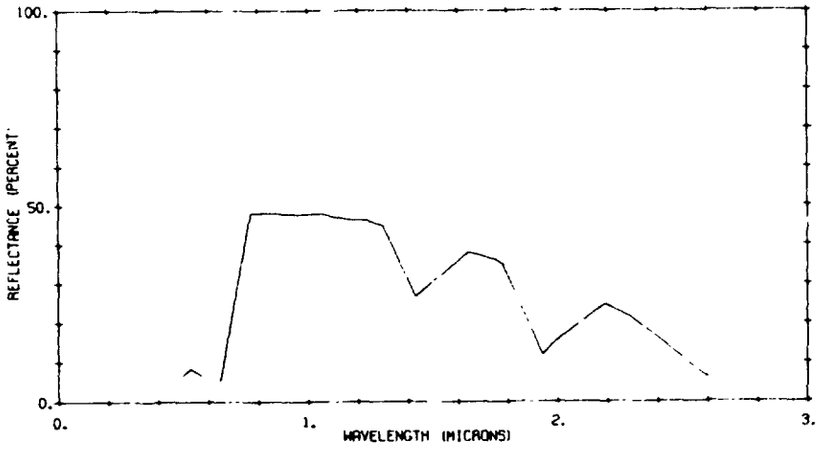
B09007 329

TREE 8, LEAF 4. NO WATER SINCE 1 MAY



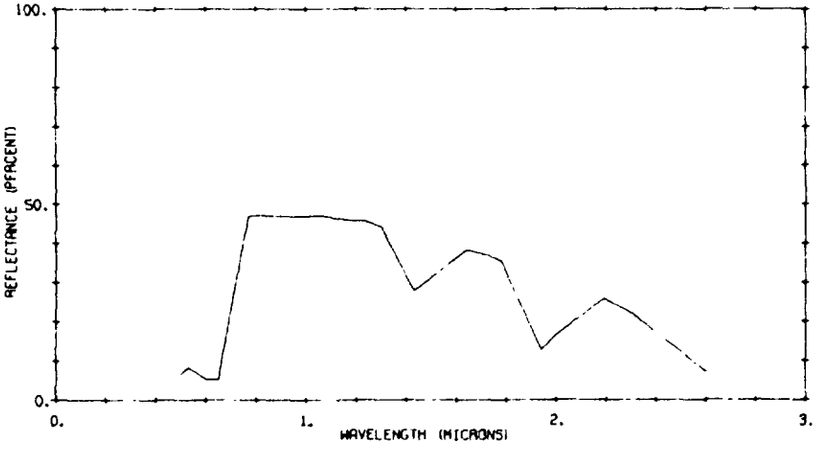
B09007 330

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



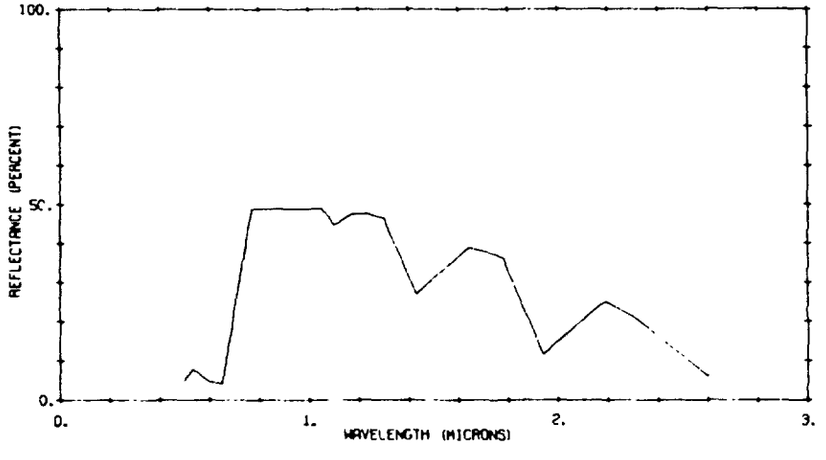
B09007 331

TREE 8, LEAF 6 NO WATER SINCE 1 MAY



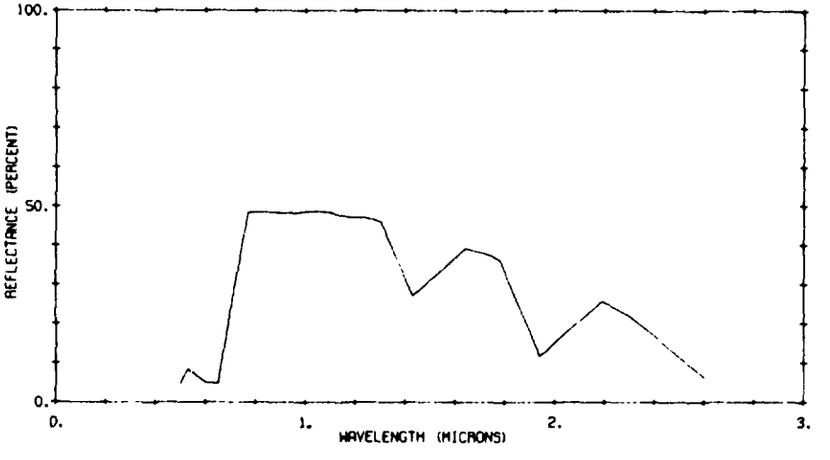
B09007 332

TREE 8, LEAF 4 NO WATER SINCE 1 MAY.



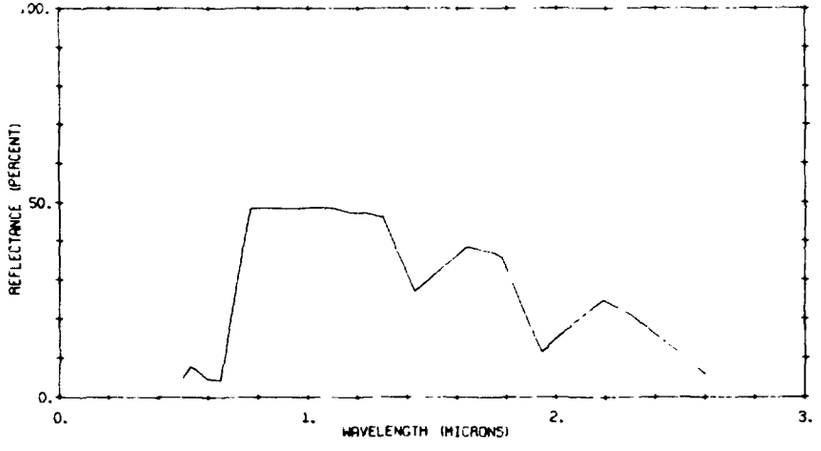
B09007 333

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



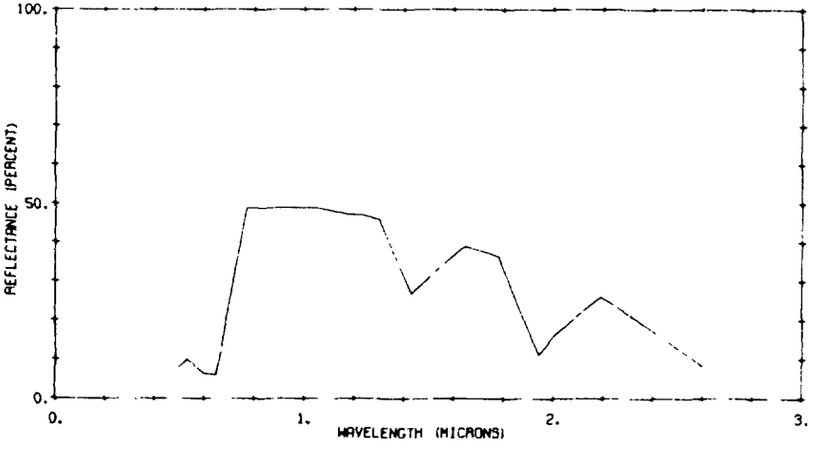
809007 334

TREE 5 LEAF 6 NO WATER SINCE 1 MAY



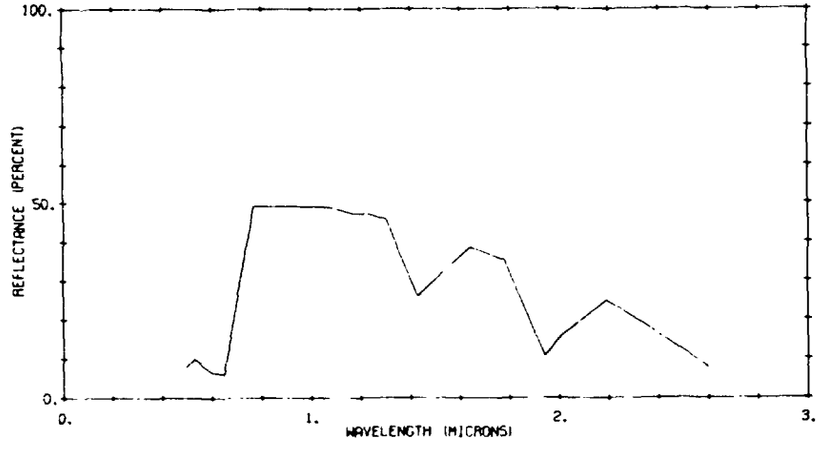
809007 335

TREE 8, LEAF 4 NO WATER SINCE 1 MAY



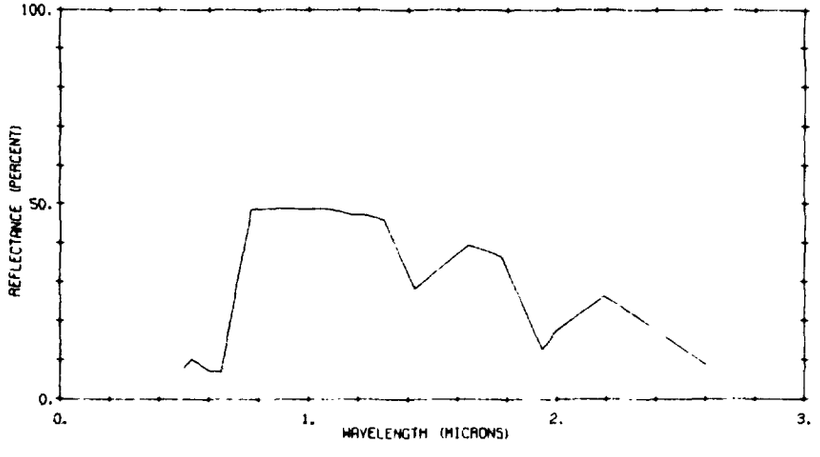
809007 336

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



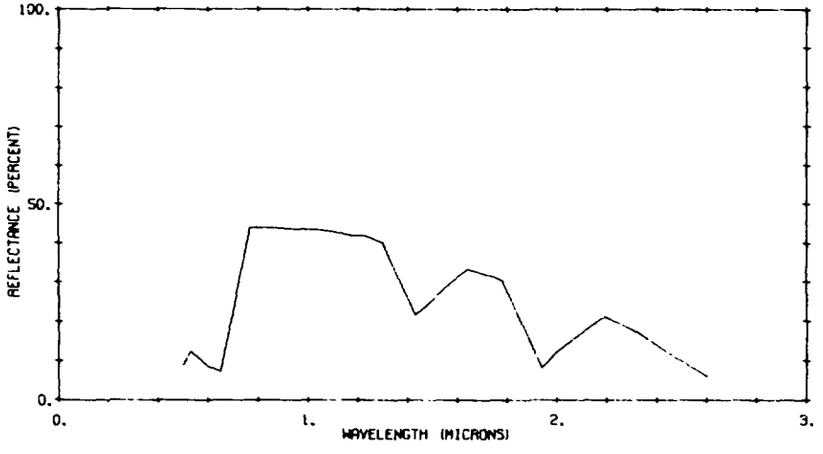
809007 337

TREE 8, LEAF 6 NO WATER SINCE 1 MAY



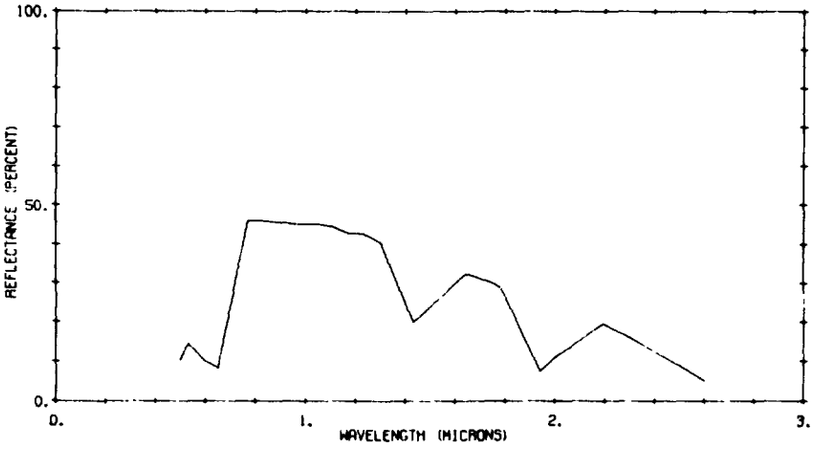
B03007 338

TREE 8, LEAF 7 NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



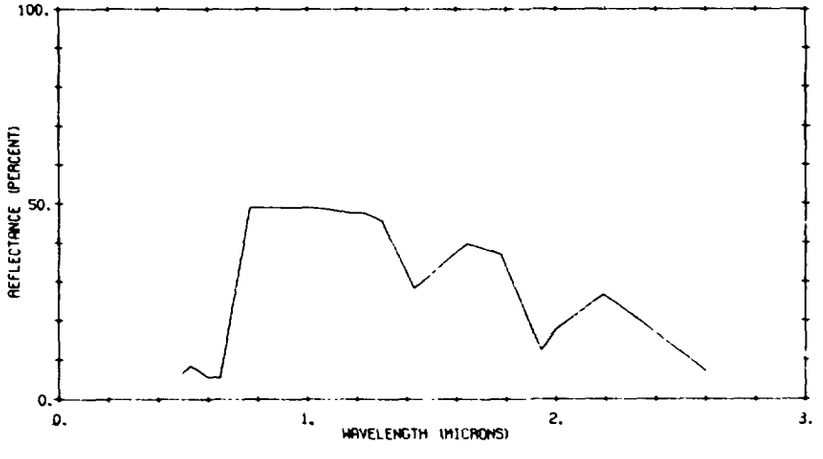
B09007 339

TREE 8, LEAF 8 NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



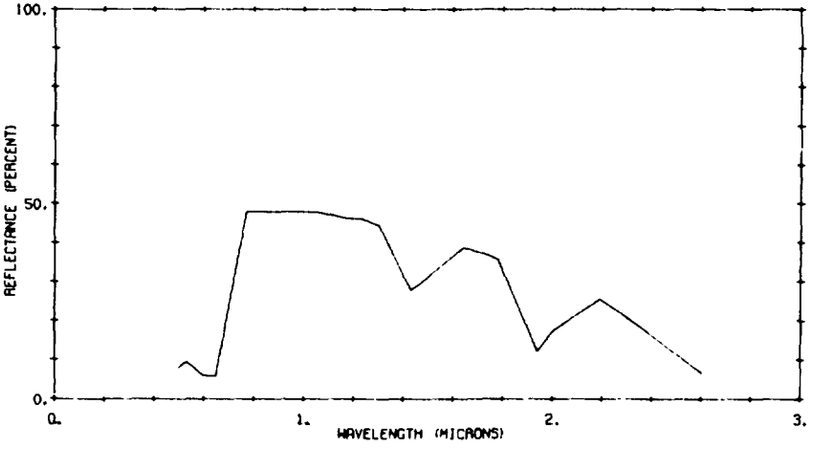
B09007 340

TREE 8, LEAF 4 NO WATER SINCE 1 MAY



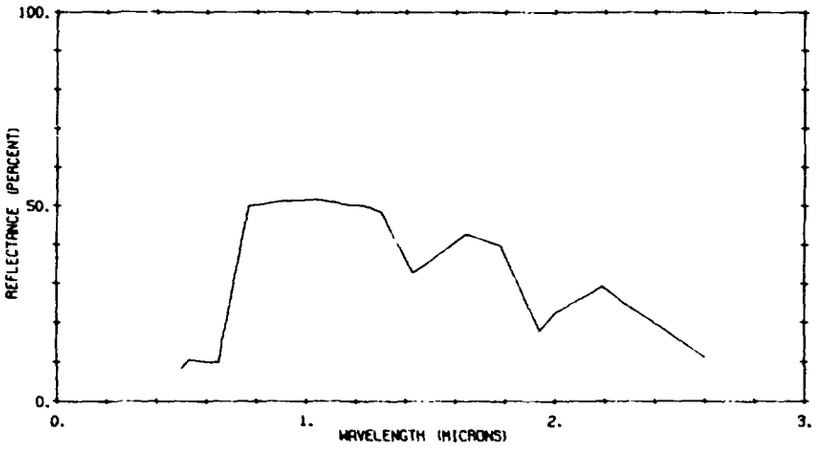
B09007 341

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



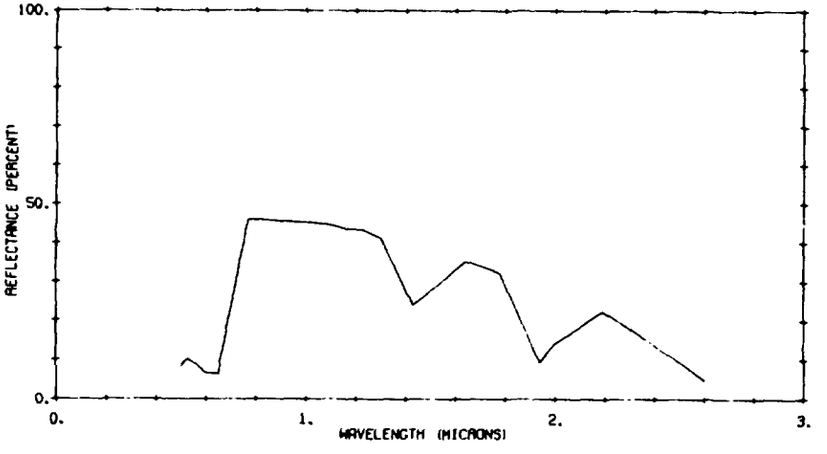
B09007 342

TREE 8, LEAF 6 NO WATER SINCE 1 MAY



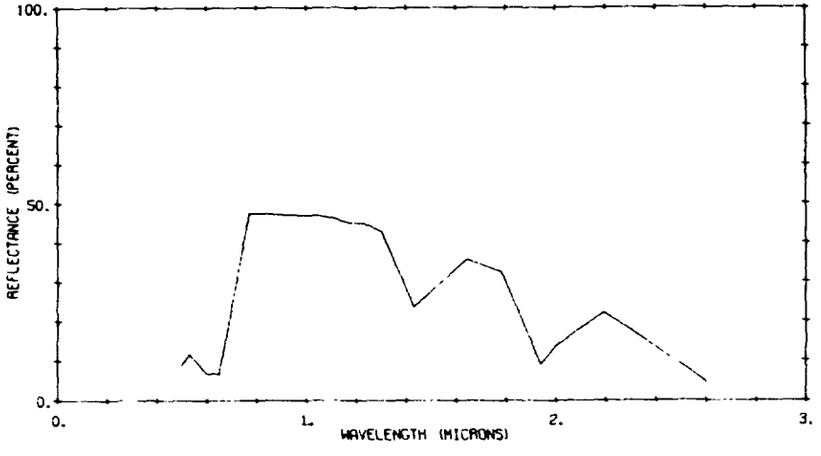
B09007 343

TREE 8, LEAF 7 NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



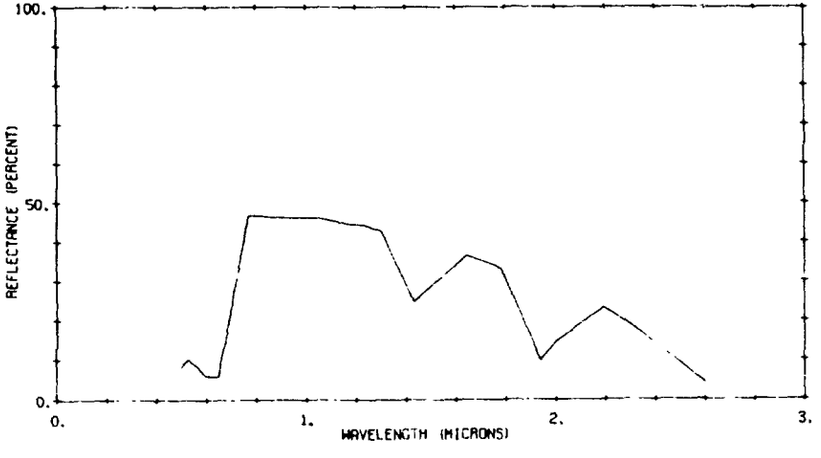
B09007 344

TREE 8, LEAF 8 NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



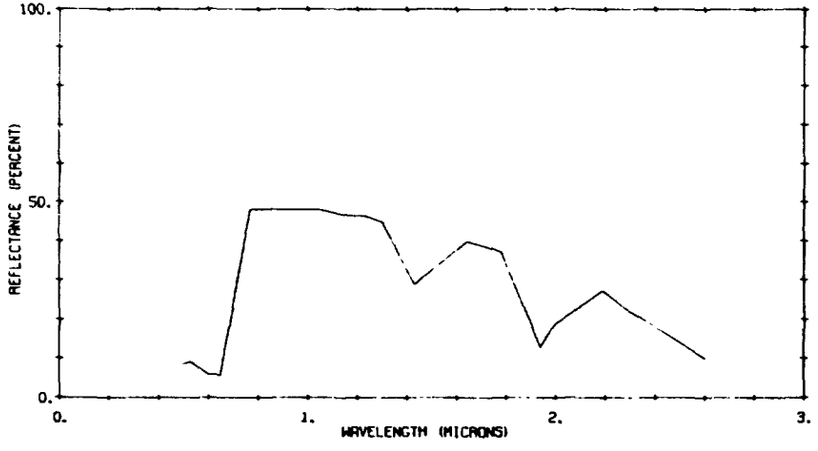
B09007 345

TREE 8, LEAF 9 NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



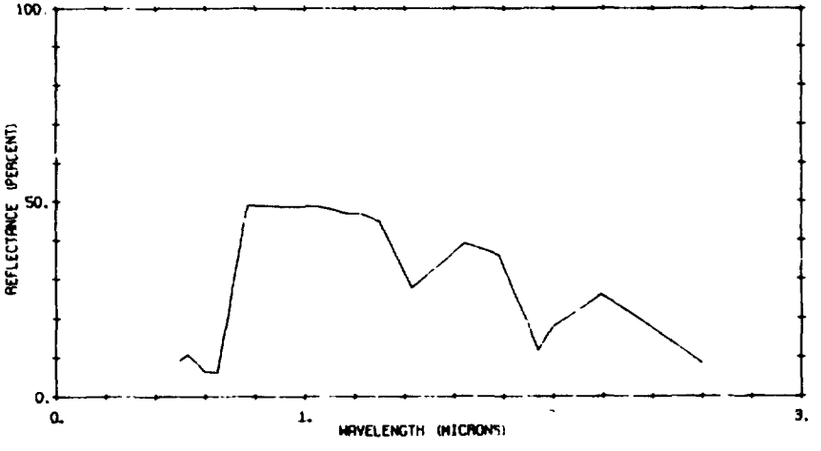
B09007 346

TREE 8, LEAF 4 NO WATER SINCE 1 MAY



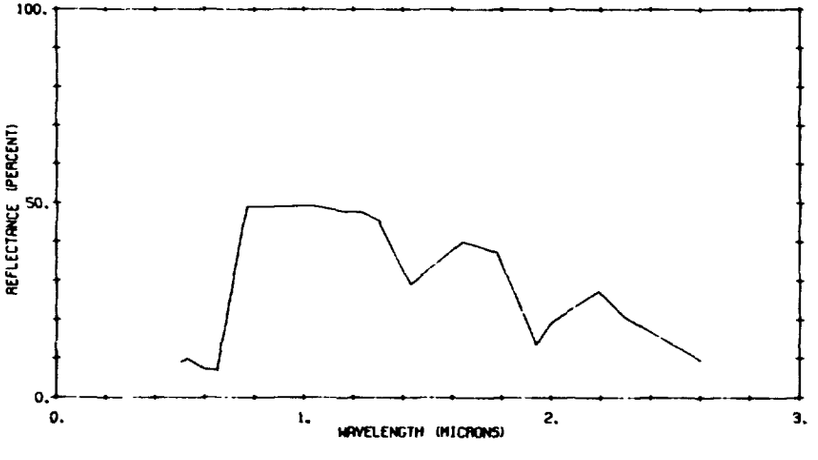
B09007 347

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



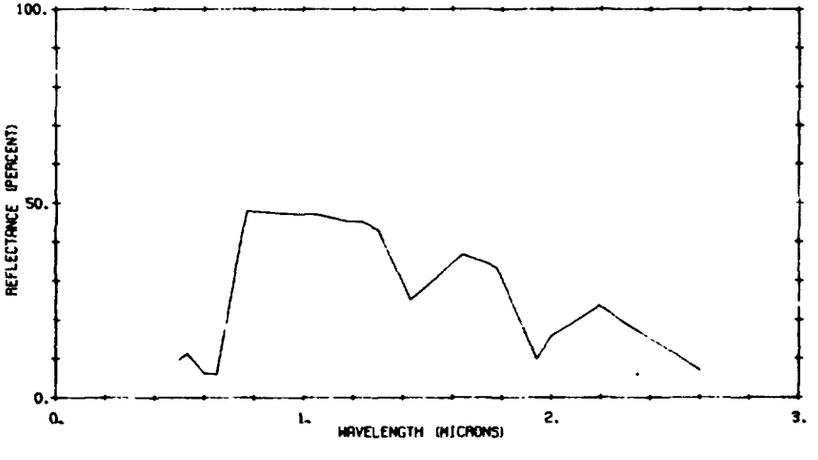
B09007 348

TREE 8, LEAF 6 NO WATER SINCE 1 MAY



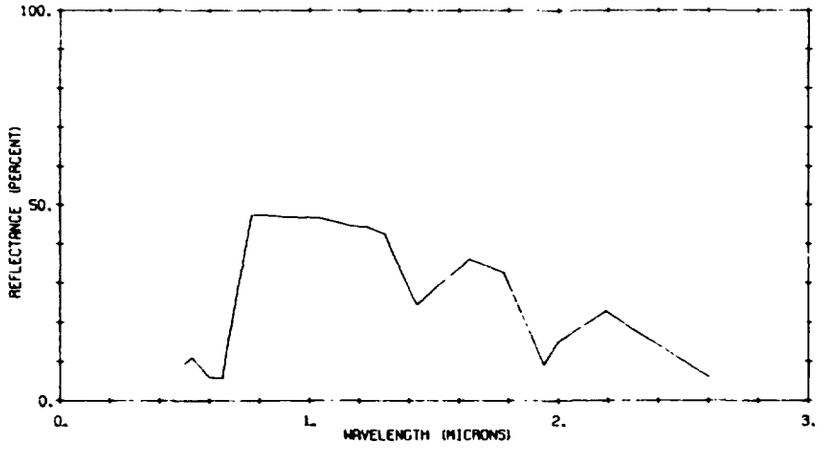
B09007 349

TREE 8, LEAF 7. NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



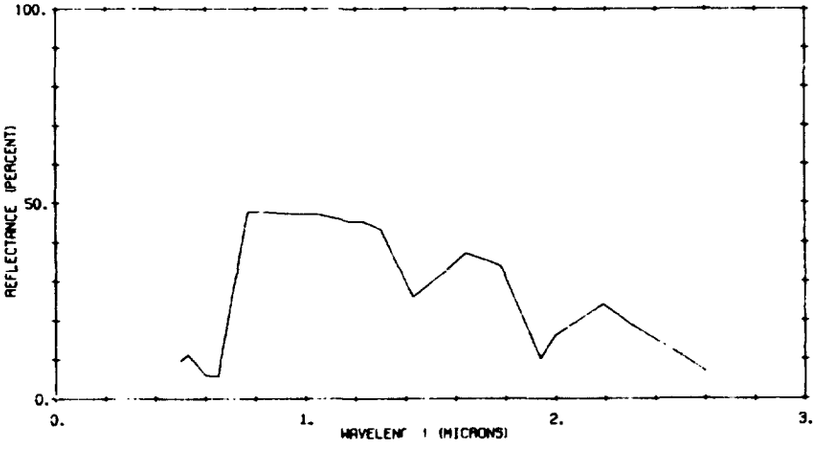
B09007 350

TREE 8, LEAF 8 NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



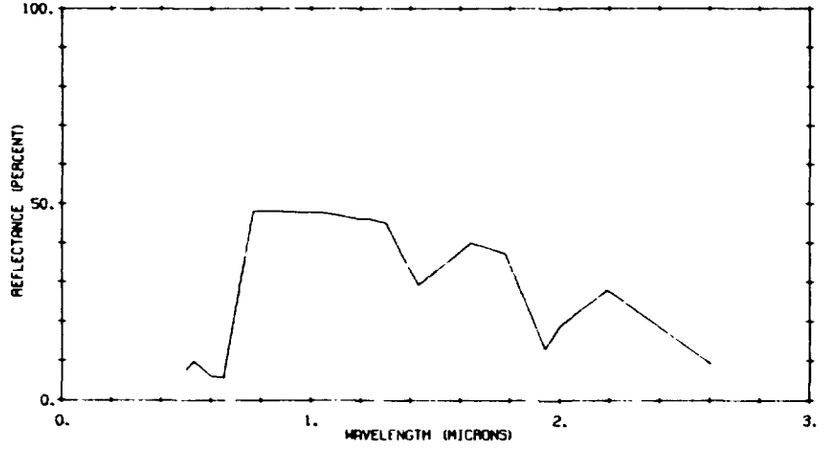
B09007 351

TREE 8, LEAF 9 NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



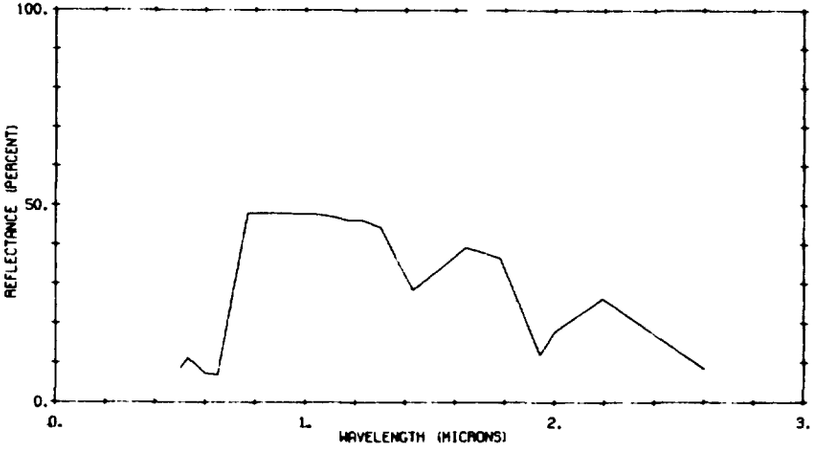
B09007 352

TREE 8, LEAF 4 NO WATER SINCE 1 MAY



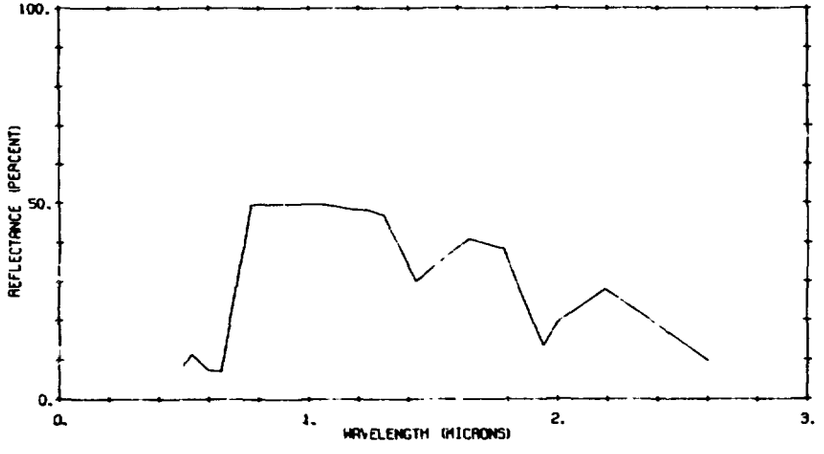
B09007 353

TREE 8, LEAF 5. NO WATER SINCE 1 MAY



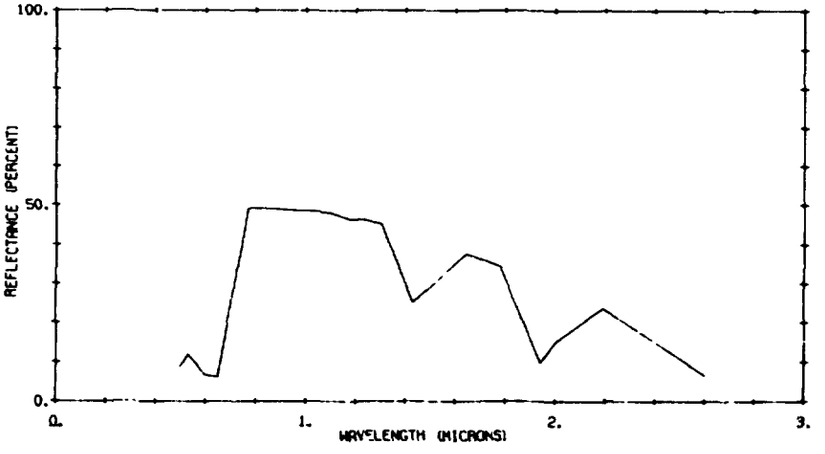
B09007 354

TREE 8, LEAF 6. NO WATER SINCE 1 MAY.



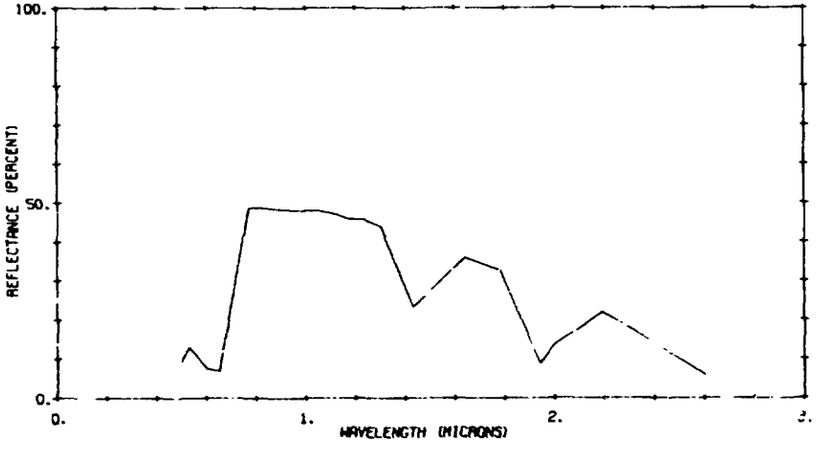
B09007 355

TREE 8, LEAF 7. NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON.



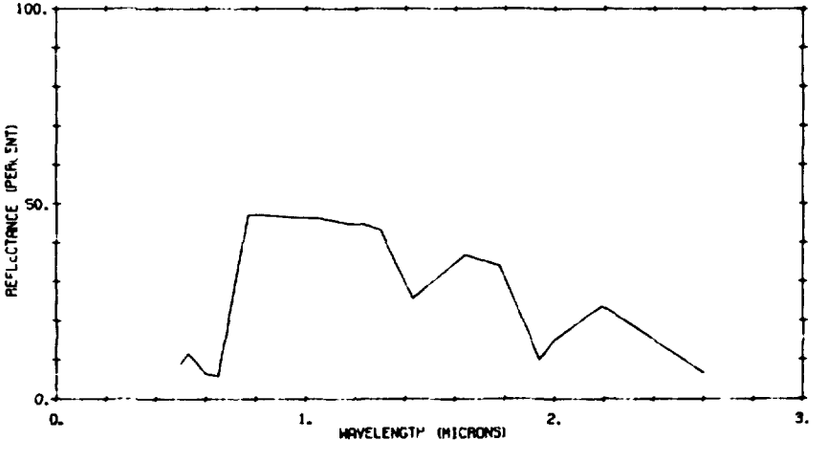
B09007 356

TREE 8, LEAF 8. NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



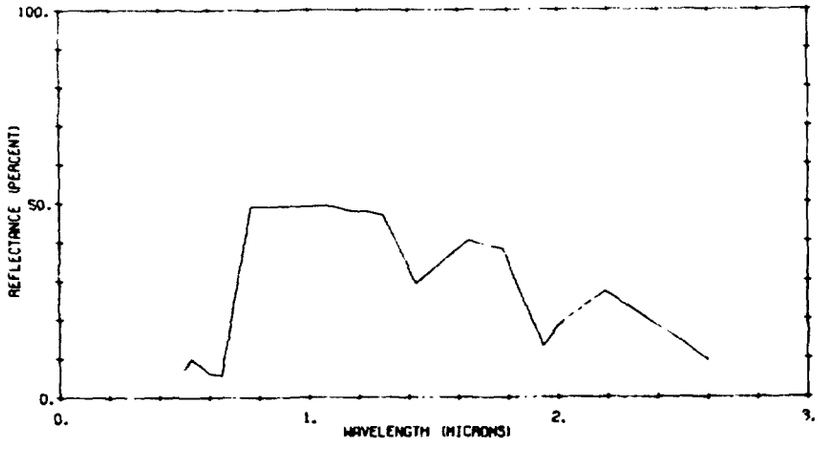
B09007 357

TREE 8, LEAF 9. NO WATER SINCE 1 MAY. LEAF FROM SECOND FLUSH OF SEASON



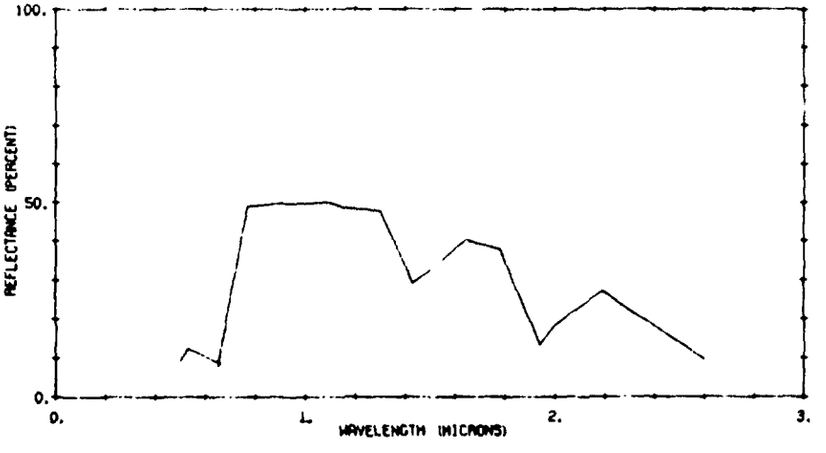
B09007 358

TREE 8, LEAF 4 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



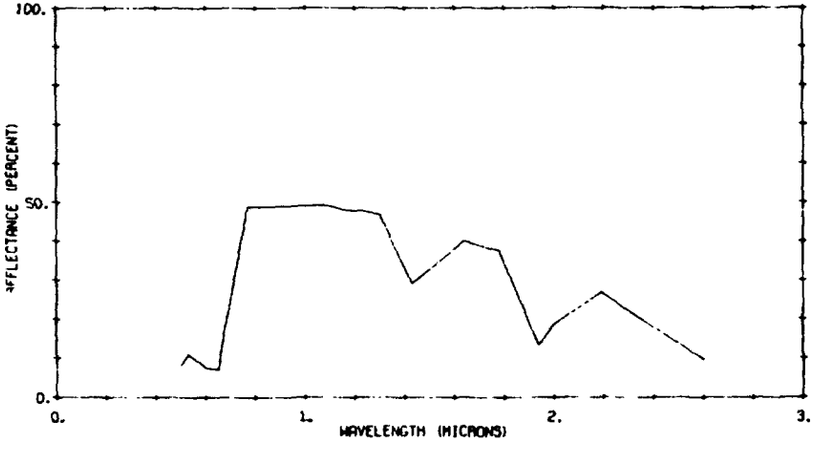
B09007 359

TREE 8, LEAF 5 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



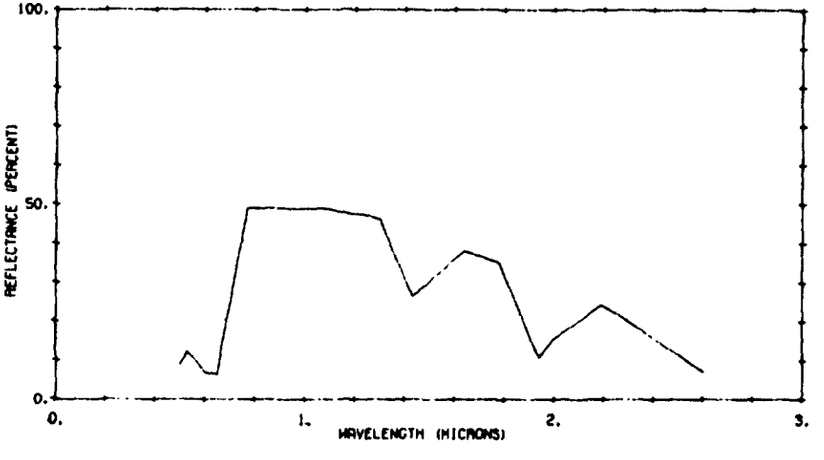
B09007 360

TREE 8, LEAF 6 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER.



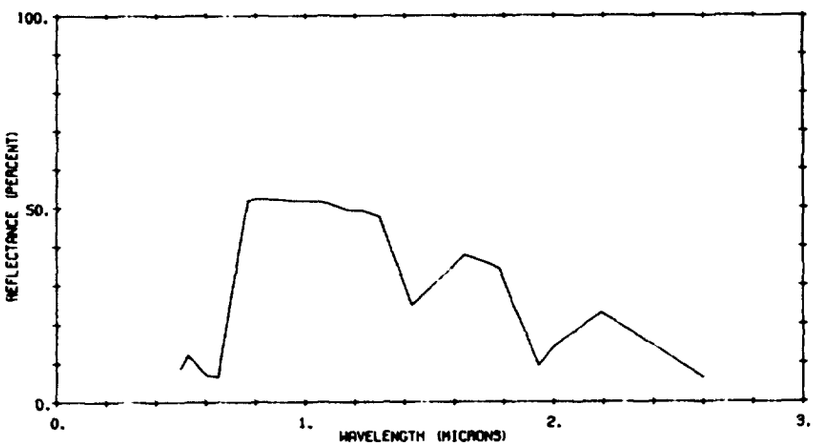
B09007 361

TREE 8, LEAF 7 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



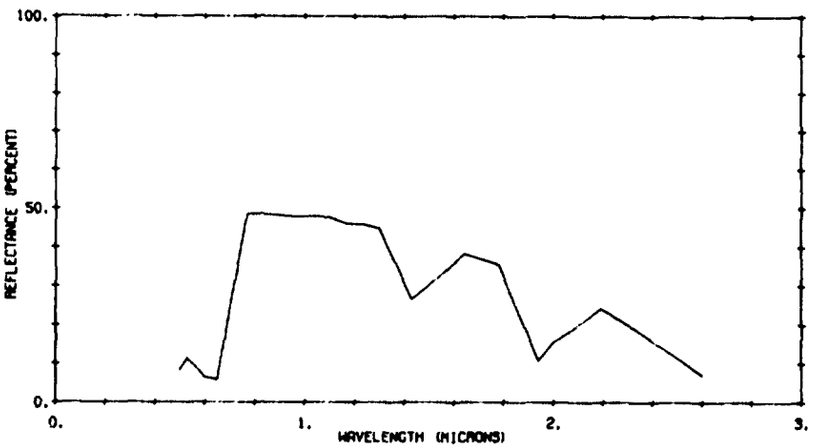
B09007 362

TREE 8, LEAF 8 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



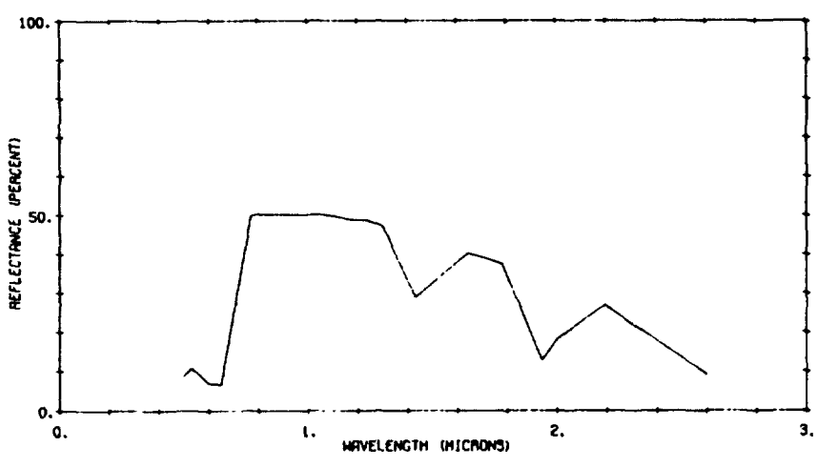
B09007 363

TREE 8, LEAF 9 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



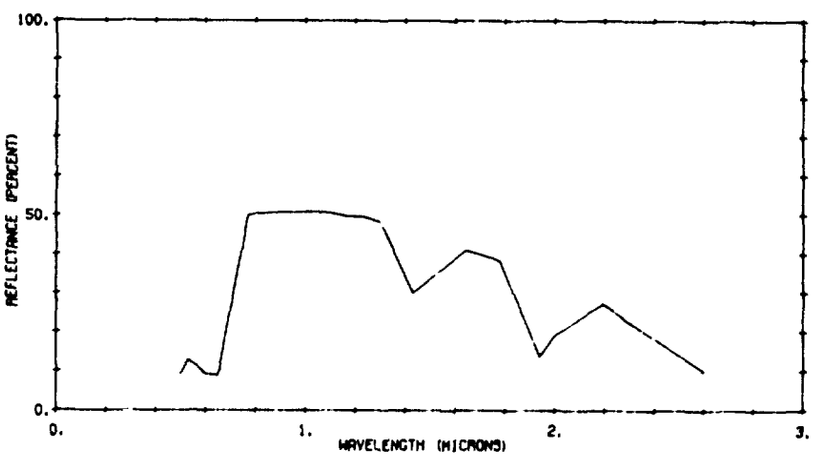
B09007 364

TREE 8, LEAF 4. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



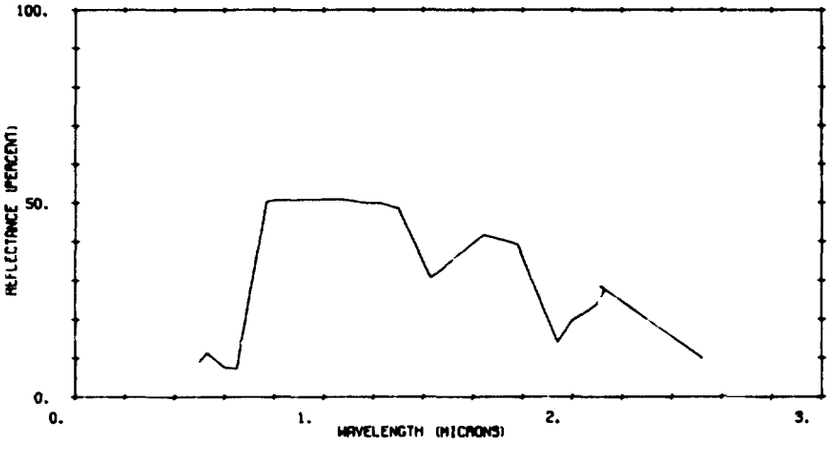
B09007 365

TREE 8, LEAF 5 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER.



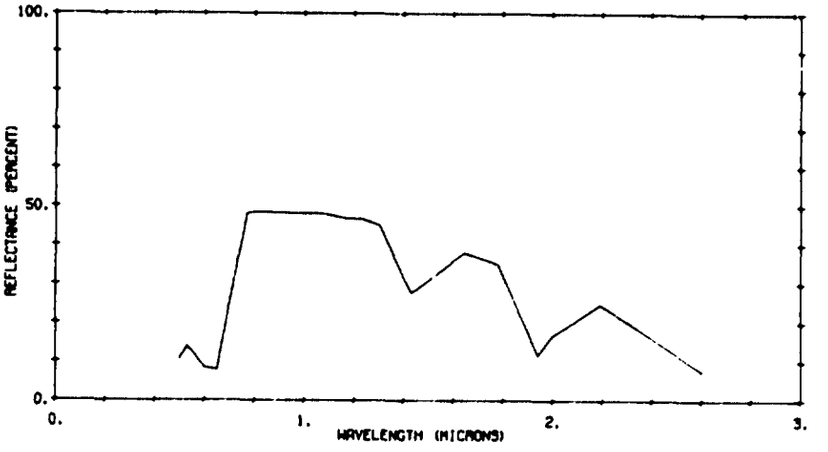
B09007 366

TREE 8, LEAF 6 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



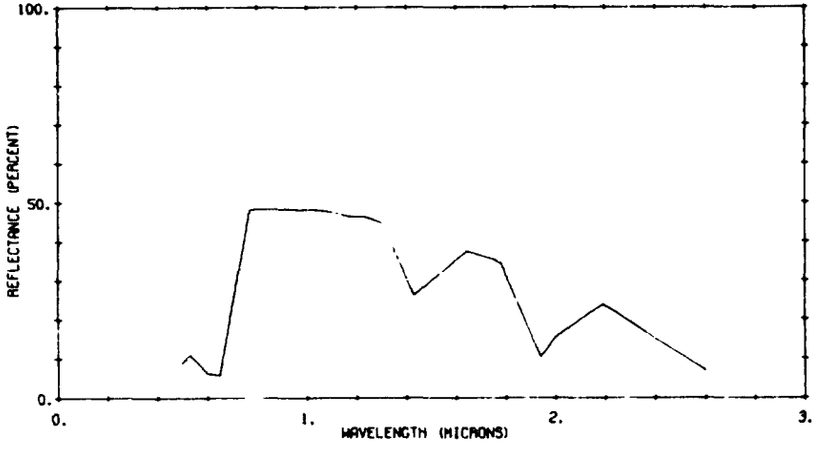
B09007 367

TREE 8, LEAF 7. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER.



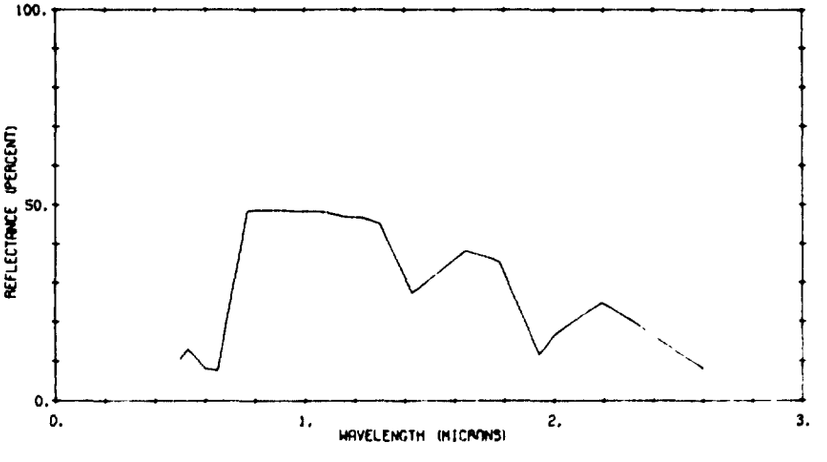
B09007 368

TREE 8, LEAF 8 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



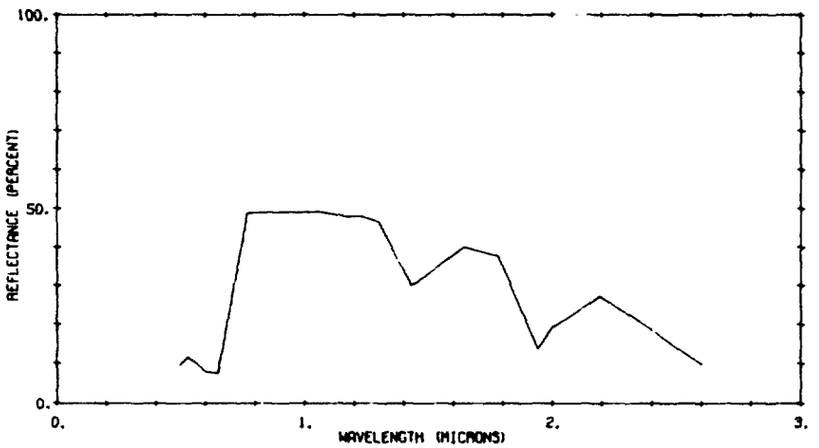
B09007 369

TREE 8, LEAF 9. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



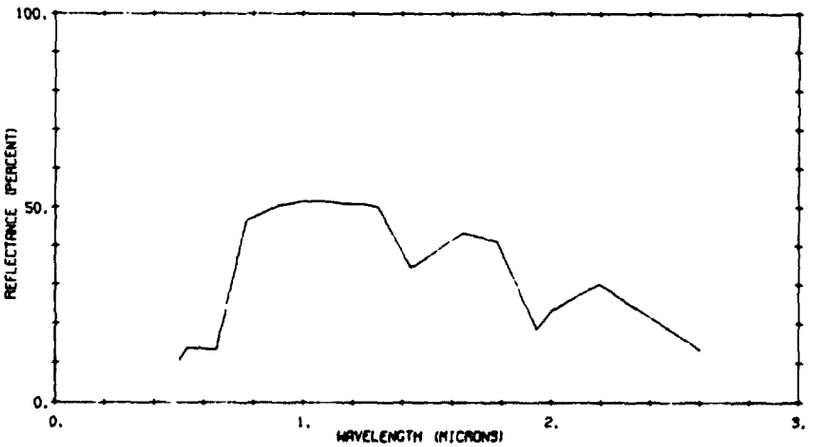
809007 370

TREE 8, LEAF 4 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



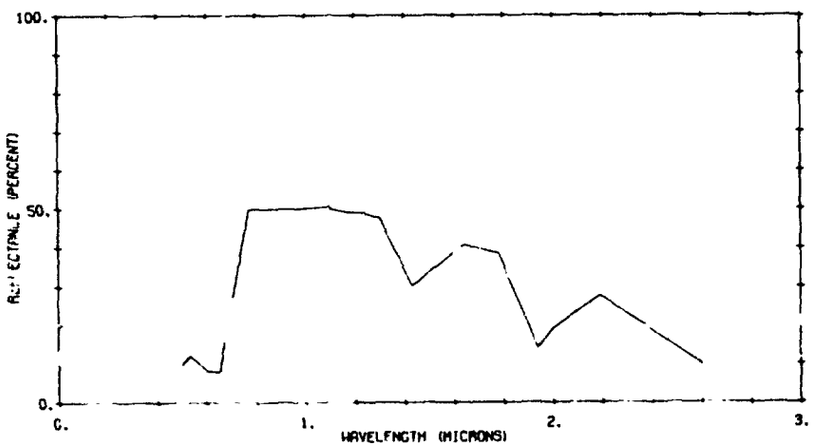
809007 371

TREE 8, LEAF 5. NO WATER 1 MAY TO 12 JULY. WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



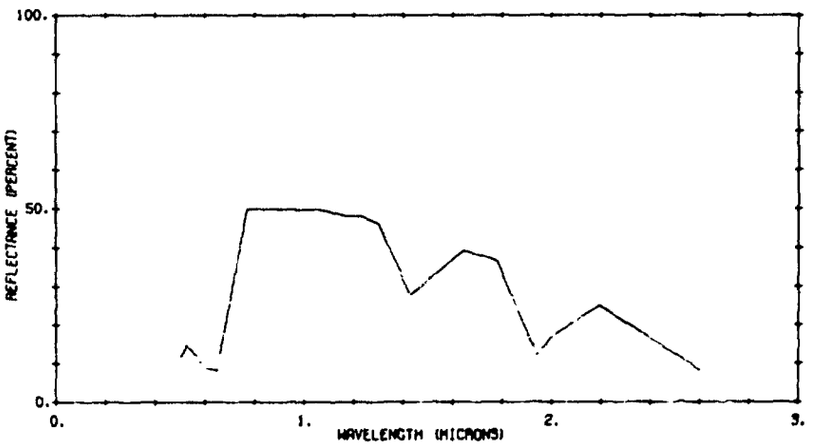
809007 372

TREE 8, LEAF 6 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



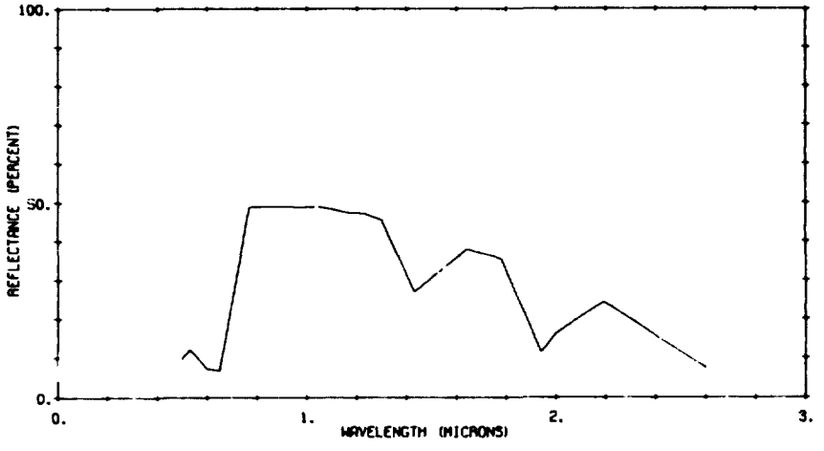
809007 373

TREE 8, LEAF 7 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER.



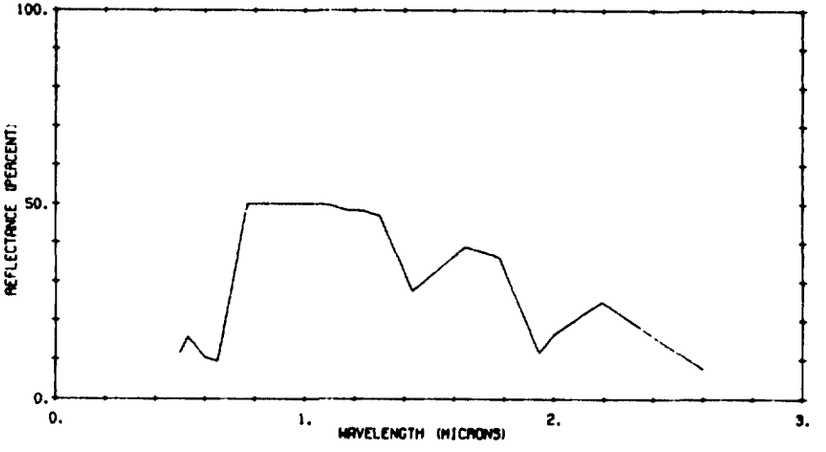
809007 374

TREE 8, LEAF 8 NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER



809007 375

TREE 8, LEAF 9. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JULY AND EVERY SECOND OR THIRD DAY THEREAFTER.



Further Comments on Document B09007

The red oak tree leaf spectral curves from document B09007 are part of a water stress study conducted by W. G. Rohde and C. E. Olson, Jr. of The University of Michigan's Department of Natural Resources. The study was begun on 1 May 1969. The following table lists the dates of spectral measurement and the water stress code for each red oak leaf curve in this section. The document number has been suppressed in the curve number listing, e.g., curve 012 is actually ERSIS curve B09007012. The key to the water stress code is as follows:

1 = Watered every second or third day since 1 May

2 = Not watered since 18 June

3 = Not watered between 18 June to 25 June; watered every second or third day thereafter

4 = Not watered since 1 May

5 = Not watered between 1 May to 12 July; watered every second or third day thereafter

DATE OF MEASUREMENT AND WATER STRESS CODE
FOR SPECTRAL CURVES FROM DOCUMENT B09007
(ALL FOR YEAR 1969)

Curve No.	Date of Spectral Measurement	Water Stress Code	Curve No.	Date of Spectral Measurement	Water Stress Code
001	19 May	1	028	2 July	1
002	19 May	1	029	2 July	1
003	19 May	1	030	2 July	1
004	26 May	1	031	15 July	1
005	26 May	1	032	15 July	1
006	26 May	1	033	15 July	1
007	2 June	1	034	30 July	1
008	2 June	1	035	30 July	1
009	2 June	1	036	30 July	1
010	6 June	1	037	5 August	1
011	6 June	1	038	5 August	1
012	6 June	1	039	5 August	1
013	9 June	1	040	18 August	1
014	9 June	1	041	18 August	1
015	9 June	1	042	18 August	1
016	13 June	1	043	19 May	1
017	13 June	1	044	19 May	1
018	13 June	1	045	19 May	1
019	16 June	1	046	26 May	1
020	16 June	1	047	26 May	1
021	16 June	1	048	26 May	1
022	23 June	1	049	2 June	1
023	23 June	1	050	2 June	1
024	23 June	1	051	2 June	1
025	2 July	1	052	6 June	1
026	2 July	1	053	6 June	1
027	2 July	1	054	6 June	1
			055	9 June	1

Curve No.	Date of Spectral Measurement	Water Stress Code	Curve No.	Date of Spectral Measurement	Water Stress Code
056	9 June	1	101	13 June	1
057	9 June	1	102	13 June	1
058	13 June	1	103	16 June	1
059	13 June	1	104	16 June	1
060	13 June	1	105	16 June	1
061	16 June	1	106	16 June	1
062	16 June	1	107	16 June	1
063	16 June	1	108	16 June	1
064	23 June	1	109	23 June	1
065	23 June	1	110	23 June	1
066	23 June	1	111	23 June	1
067	2 July	1	112	23 June	1
068	2 July	1	113	23 June	1
069	2 July	1	114	23 June	1
070	8 July	1	115	2 July	1
071	8 July	1	116	2 July	1
072	8 July	1	117	2 July	1
073	15 June	1	118	2 July	1
074	15 June	1	119	2 July	1
075	15 June	1	120	2 July	1
076	30 July	1	121	8 July	1
077	30 July	1	122	8 July	1
078	30 July	1	123	8 July	1
079	5 August	1	124	8 July	1
080	5 August	1	125	8 July	1
081	5 August	1	126	8 July	1
082	18 August	1	127	15 July	1
083	18 August	1	128	15 July	1
084	18 August	1	129	15 July	1
085	19 May	1	130	15 July	1
086	19 May	1	131	15 July	1
087	19 May	1	132	15 July	1
088	26 May	1	133	30 July	1
089	26 May	1	134	30 July	1
090	26 May	1	135	30 July	1
091	2 June	1	136	30 July	1
092	2 June	1	137	30 July	1
093	2 June	1	138	30 July	
094	6 June	1	139	5 August	1
095	6 June	1	140	5 August	1
096	6 June	1	141	5 August	1
097	9 June	1	142	5 August	1
098	9 June	1	143	5 August	1
099	9 June	1	144	5 August	1
100	13 June	1	145	18 August	1

Curve No.	Date of Spectral Measurement	Water Stress Code	Curve No.	Date of Spectral Measurement	Water Stress Code
146	18 August	1	191	18 August	3
147	18 August	1	192	18 August	3
148	18 August	1	193	19 May	1
149	18 August	1	194	19 May	1
150	18 August	1	195	19 May	1
151	19 May	1	196	26 May	1
152	19 May	1	197	26 May	1
153	19 May	1	198	26 May	1
154	26 May	1	199	2 June	1
155	26 May	1	200	2 June	1
156	26 May	1	201	2 June	1
157	2 June	1	202	6 June	1
158	2 June	1	203	6 June	1
159	2 June	1	204	6 June	1
160	6 June	1	205	9 June	1
161	6 June	1	206	9 June	1
162	6 June	1	207	9 June	1
163	9 June	1	208	13 June	1
164	9 June	1	209	13 June	1
165	9 June	1	210	13 June	1
166	13 June	1	211	16 June	1
167	13 June	1	212	16 June	1
168	13 June	1	213	16 June	1
169	16 June	1	214	23 June	2
170	16 June	1	215	23 June	2
171	16 June	1	216	23 June	2
172	23 June	2	217	2 July	2
173	23 June	2	218	2 July	2
174	23 June	2	219	2 July	2
175	2 August	2	220	8 July	2
176	2 August	2	221	8 July	2
177	2 August	2	222	8 July	2
178	8 July	2	223	15 July	2
179	8 July	2	224	15 July	2
180	8 July	2	225	15 July	2
181	15 July	2	226	30 July	3
182	15 July	2	227	30 July	3
183	15 July	2	228	30 July	3
184	30 July	3	229	5 August	3
185	30 July	3	230	5 August	3
186	30 July	3	231	5 August	3
187	5 August	3	232	18 August	3
188	5 August	3	233	18 August	3
189	5 August	3	234	18 August	3
190	18 August	3	235	19 May	4

Curve No.	Date of Spectral Measurement	Water Stress Code	Curve No.	Date of Spectral Measurement	Water Stress Code
236	19 May	4	286	26 May	4
237	19 May	4	287	19 May	4
238	26 May	4	288	19 May	4
239	26 May	4	289	19 May	4
240	26 May	4	290	26 May	4
241	2 June	4	291	26 May	4
242	2 June	4	292	26 May	4
243	2 June	4	293	2 June	4
244	6 June	4	294	2 June	4
245	6 June	4	295	2 June	4
246	6 June	4	296	6 June	4
247	9 June	4	297	6 June	4
248	9 June	4	298	6 June	4
249	9 June	4	299	9 June	4
250	13 June	4	300	9 June	4
251	13 June	4	301	9 June	4
252	13 June	4	302	16 June	4
253	16 June	4	303	16 June	4
254	16 June	4	304	16 June	4
255	16 June	4	305	23 June	4
256	23 June	4	306	23 June	4
257	23 June	4	307	23 June	4
258	23 June	4	308	2 July	4
259	2 July	4	309	2 July	4
260	2 July	4	310	2 July	4
261	2 July	4	311	15 July	4
262	8 July	4	312	15 July	4
263	8 July	4	313	15 July	4
264	8 July	4	314	19 May	4
265	15 August	4	315	19 May	4
266	15 August	4	316	19 May	4
267	15 August	4	317	26 May	4
268	15 August	4	318	26 May	4
269	15 August	4	319	26 May	4
270	15 August	4	320	2 June	4
271	30 August	5	321	2 June	4
272	30 August	5	322	2 June	4
273	30 August	5	323	6 June	4
274	30 August	5	324	6 June	4
275	30 August	5	325	6 June	4
276	30 August	5	326	9 June	4
277	5 August	5	327	9 June	4
278	5 August	5	328	9 June	4
279	5 August	5	329	13 June	4
280	18 August	5	330	13 June	4
281	18 August	5	331	13 June	4
282	18 August	5	332	16 June	4
283	19 June	4	333	16 June	4
284	19 June	4	334	16 June	4
285	26 May	4	335	23 June	4

Curve No.	Date of Spectral Measurement	Water Stress Code	Curve No.	Date of Spectral Measurement	Water Stress Code
336	23 June	4	356	8 July	4
337	23 June	4	357	8 July	4
338	23 June	4	358	30 July	5
339	23 June	4	359	30 July	5
340	2 July	4	360	30 July	5
341	2 July	4	361	30 July	5
342	2 July	4	362	30 July	5
343	2 July	4	363	30 July	5
344	2 July	4	364	5 August	5
345	2 July	4	365	5 August	5
346	8 July	4	366	5 August	5
347	8 July	4	367	5 August	5
348	8 July	4	368	5 August	5
349	8 July	4	369	5 August	5
350	8 July	4	370	18 August	5
351	8 July	4	371	18 August	5
352	8 July	4	372	18 August	5
353	8 July	4	373	18 August	5
354	8 July	4	374	18 August	5
355	8 July	4	375	18 August	5

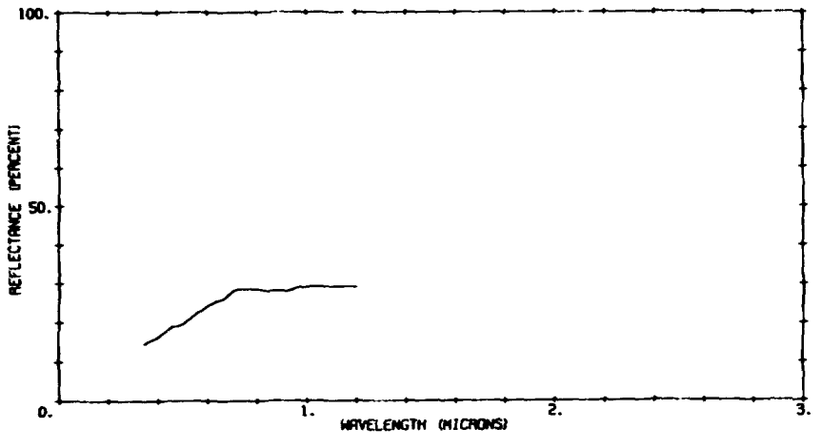
101

ACIDIC SILICATE ROCKS

(Generally greater than 65% SiO_2)

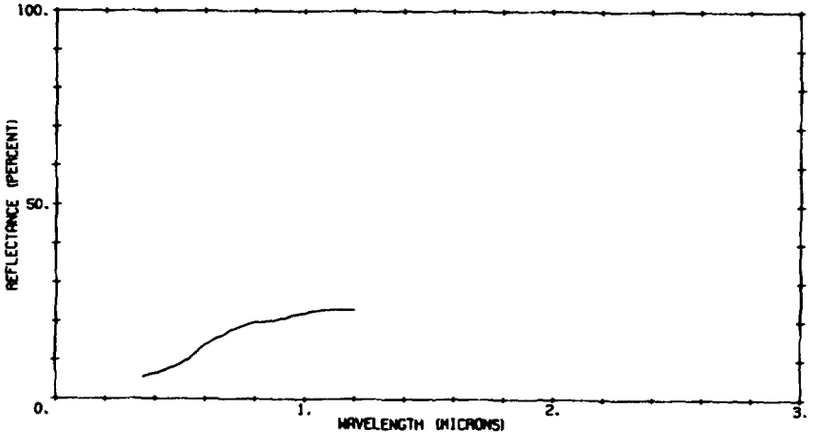
A09025 101

RHYODACITE (2A3) PISGAH SAMPLE FRESH



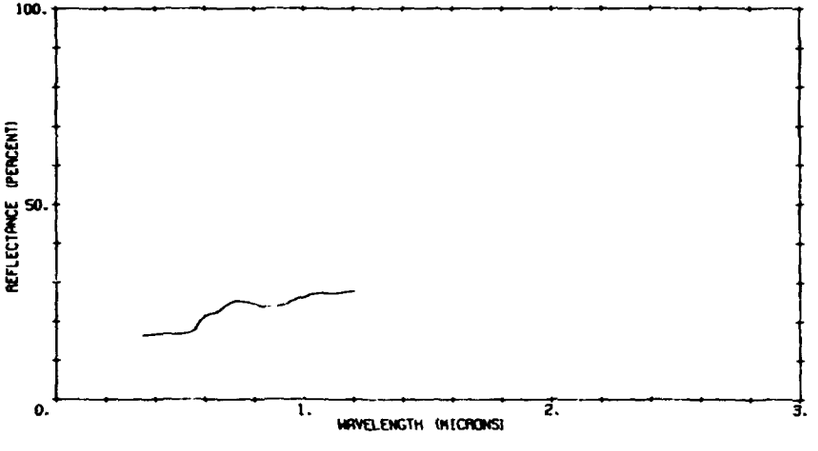
A09025 201

RHYODACITE (2A3) PISGAH SAMPLE WEATHERED



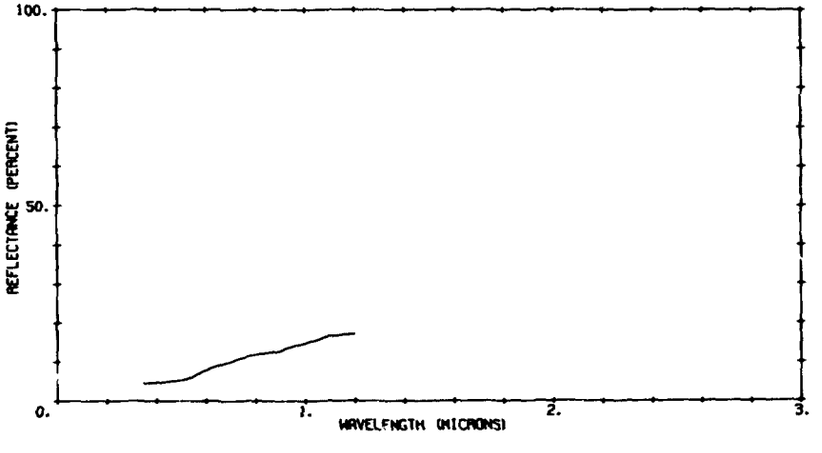
A09031 101

RHYODACITE (2A8) PISGAH SAMPLE FRESH.



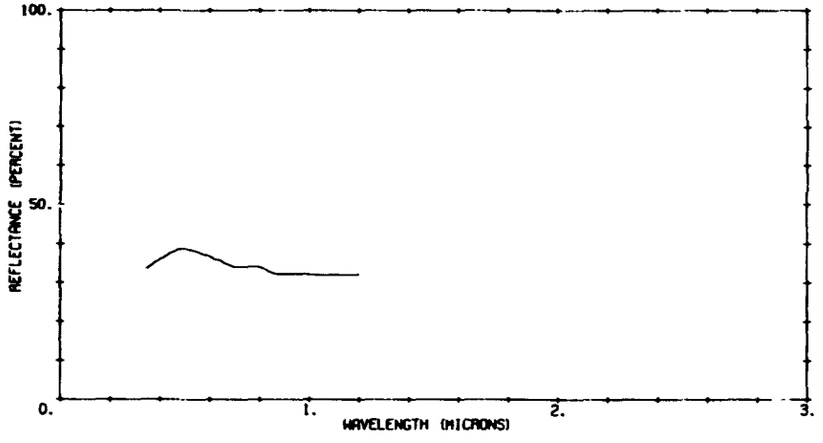
A09031 201

RHYODACITE (2A8) PISGAH SAMPLE WEATHERED.



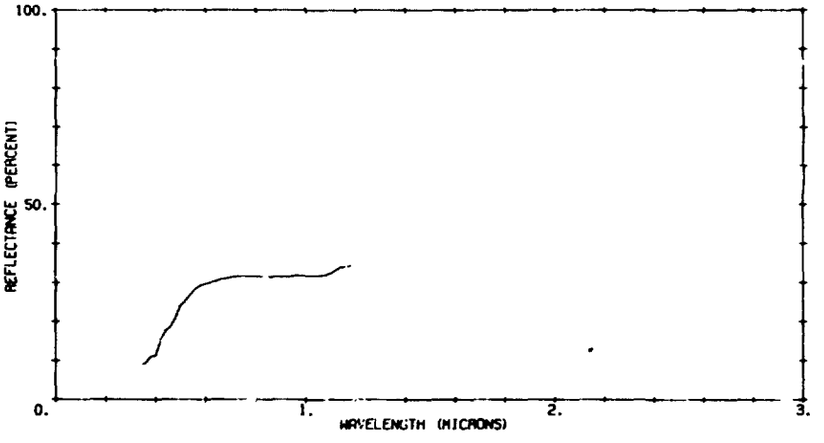
A09027 101

DACITE PORPHYRY (2A4) PISGAH SAMPLE FRESH



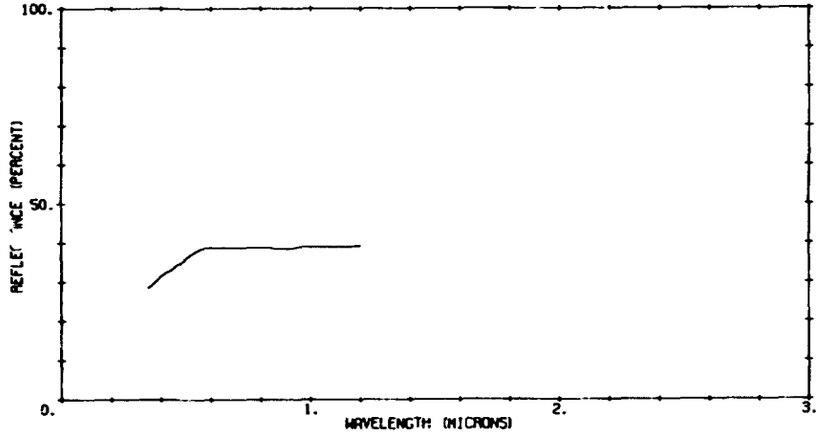
A09027 201

DACITE PORPHYRY (2A4) PISGAH SAMPLE WEATHERED



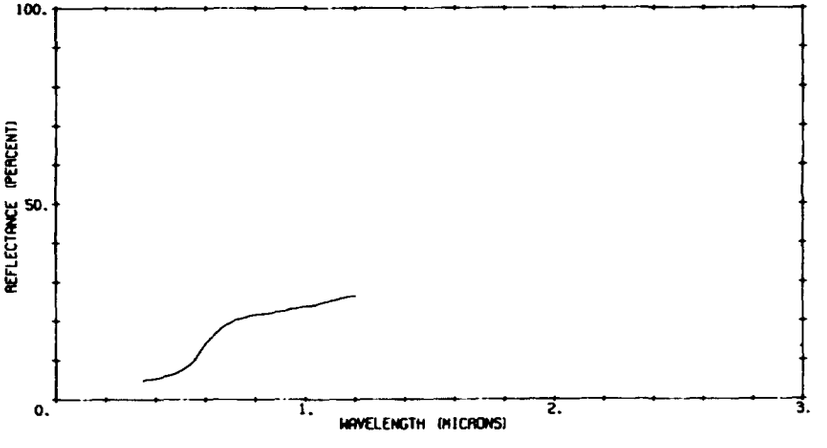
A09028 101

DACITE PORPHYRY (2A5) PISGAH SAMPLE FRESH



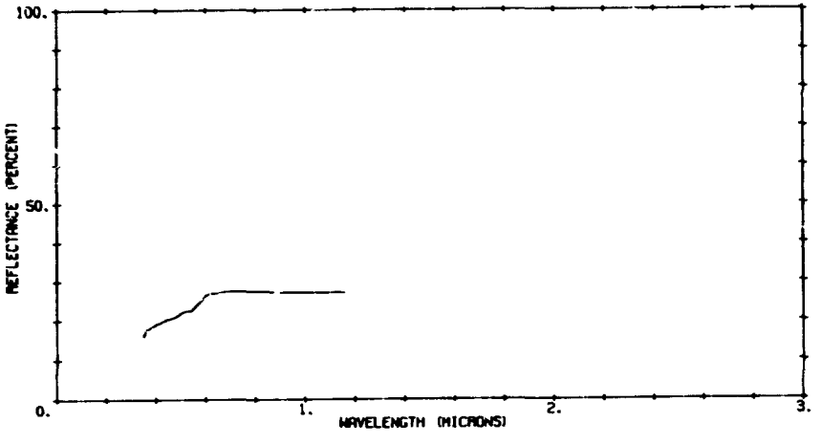
A09028 201

DACITE PORPHYRY (2A5) PISGAH SAMPLE WEATHERED



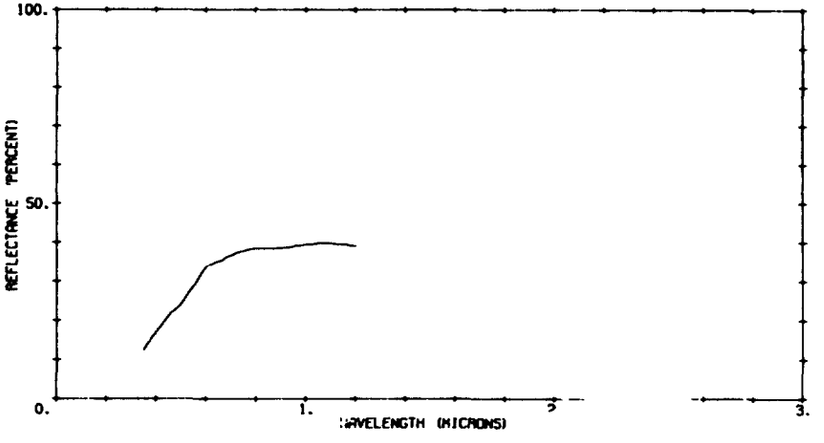
A09036 101

TUFF (2B4)1) NORTH OF CINDER CONE, PISGAH CRATER FRESH.



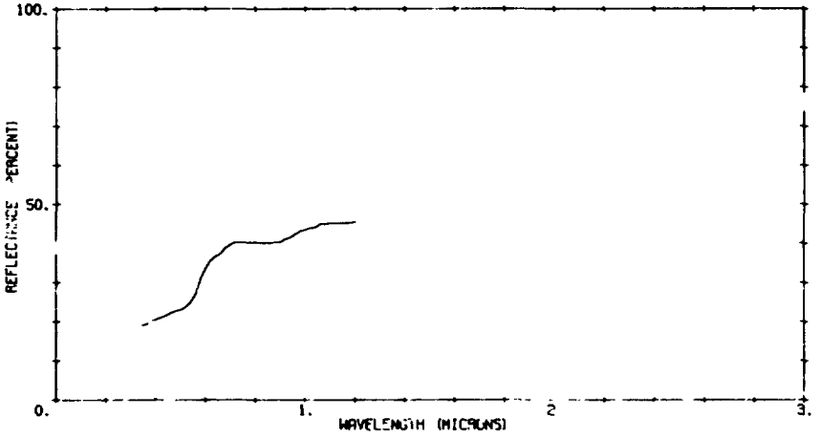
A09036 201

TUFF (2B4)1) NORTH OF CINDER CONE, PISGAH CRATER WEATHERED.



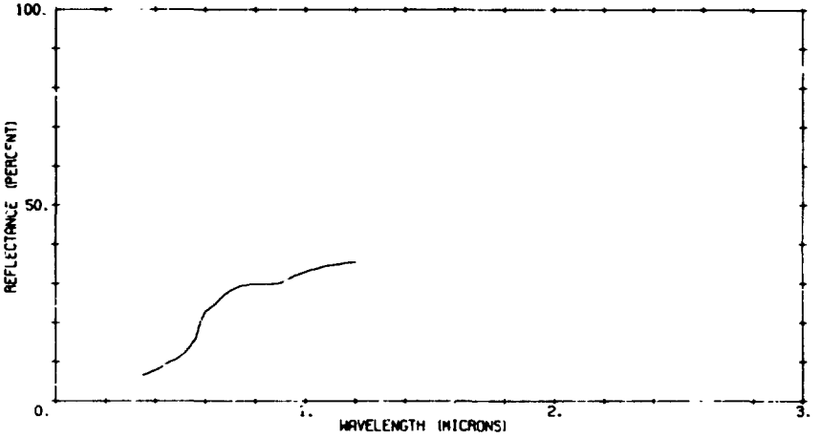
A09038 101

RHYOLITE BRECCIA (2B6, PISGAH CRATER FRESH.



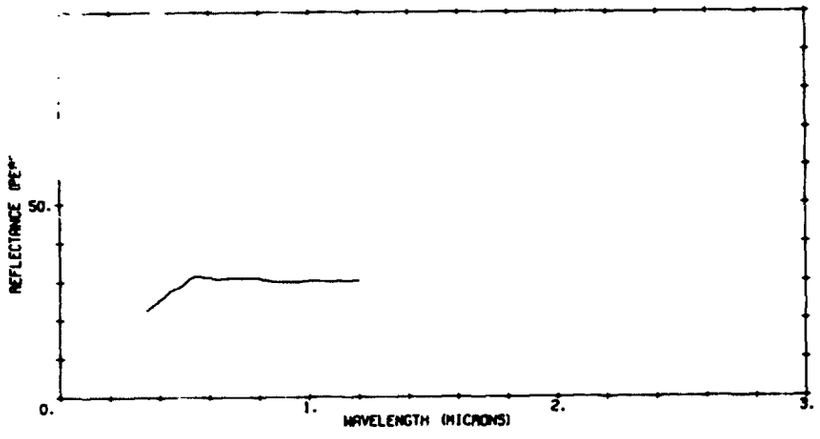
A09038 201

RHYOLITE BRECCIA (2B6) PISGAH CRATER WEATHERED



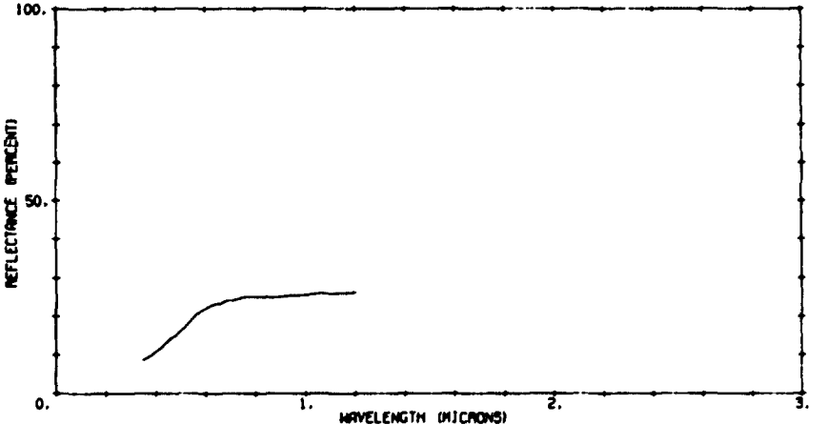
A09037 101

- NZONITE (- PISGAH CRATER FRESH SURFACE



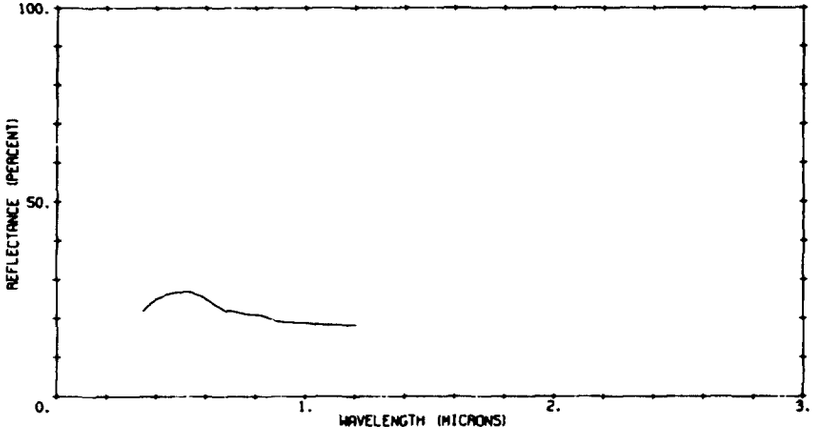
A09037 201

MONZONITE (2B5) PISGAH CRATER WEATHERED SURFACE



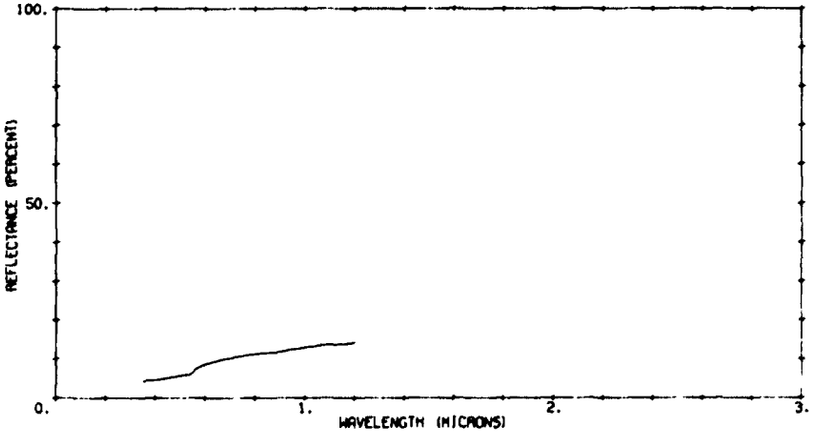
A09030 101

MONZONITE PORPHYRY (2A7) PISGAH SAMPLE FRESH



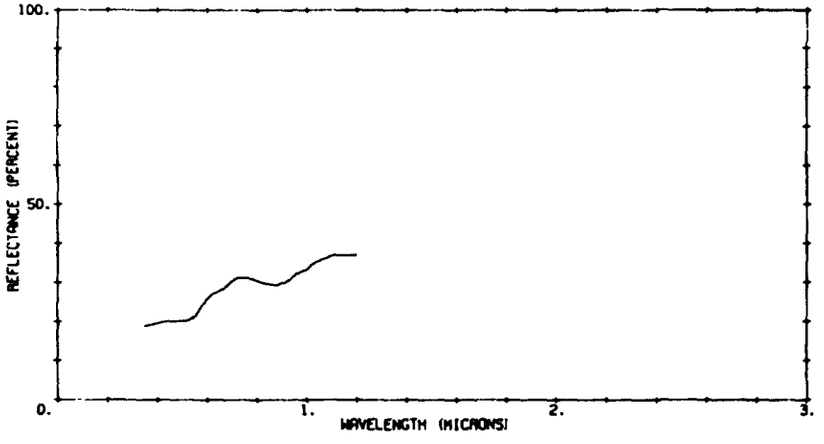
A09030 201

MONZONITE PROPHYRY (2A7) PISGAH SAMPLE WEATHERED.



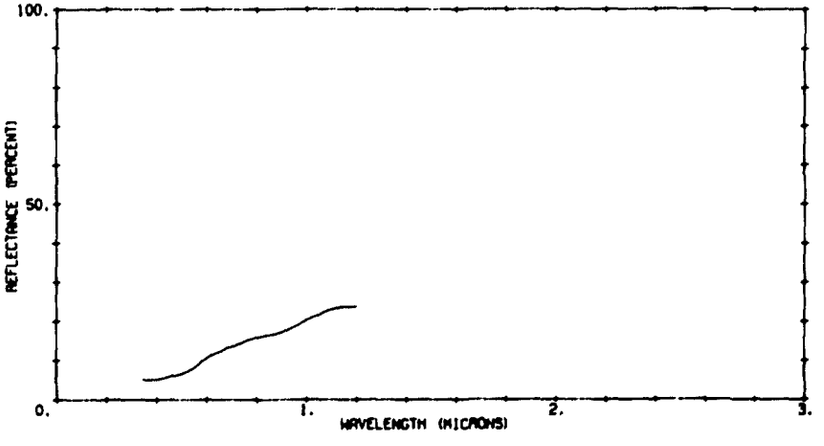
A09032 101

VESICULAR RHYODACITE (2A9) PISGAH SAMPLE FRESH



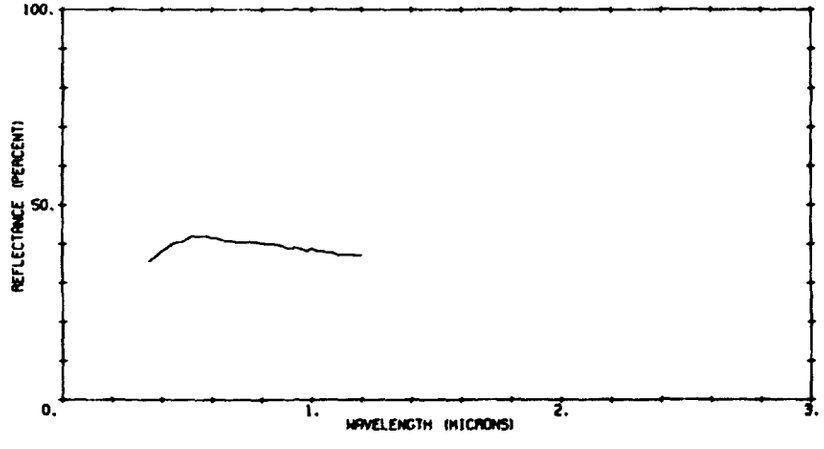
A09032 201

VESICULAR RHYODACITE (2A9) PISGAH SAMPLE WEATHERED



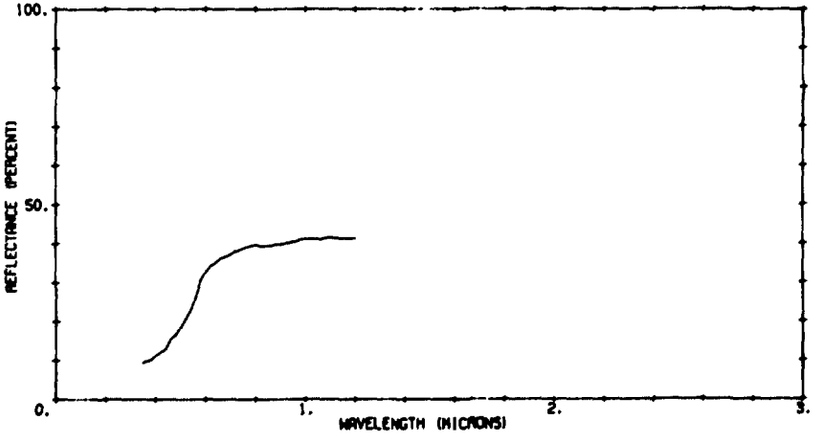
A09024 101

QUARTZ MONZONITE (2A2) PISGAH SAMPLE FRESH.



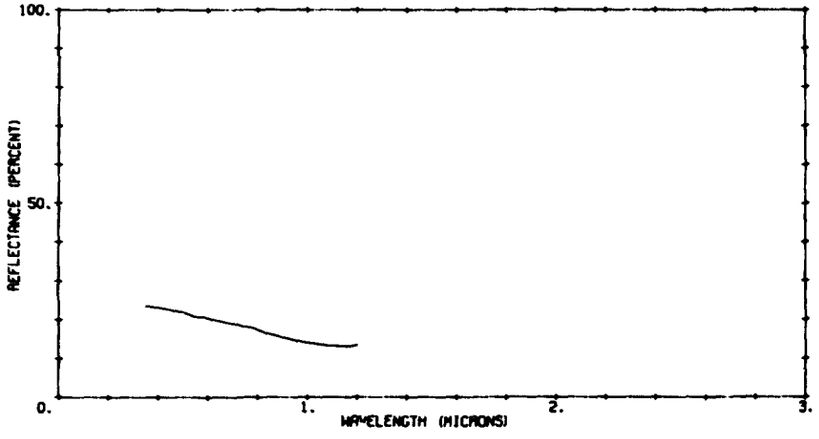
A09024 201

QUARTZ MONZONITE (2A2) PISGAH SAMPLE WEATHERED



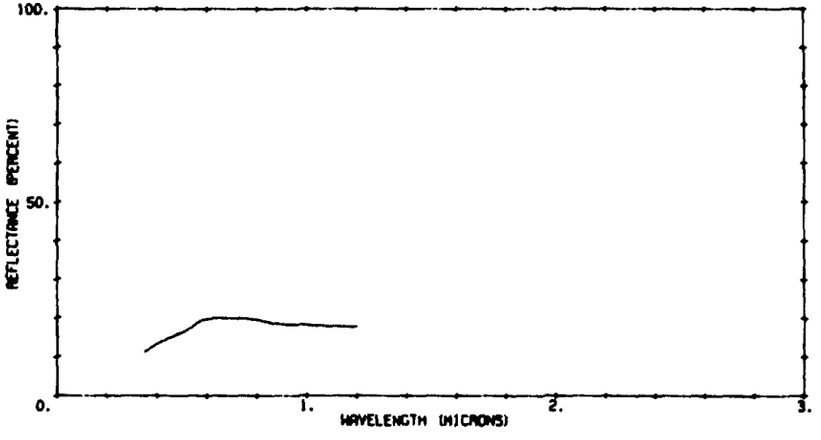
A09033 101

DACITE (2B1) NORTH OF CINDER CONE, PISGAH CRATER FRESH.



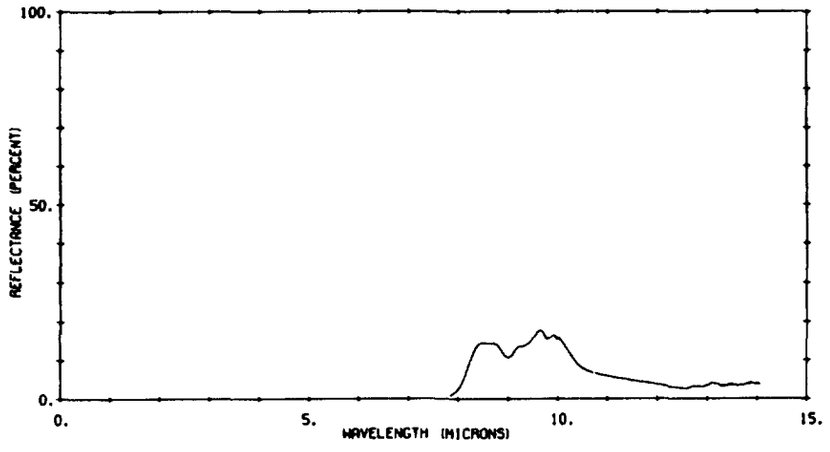
A09033 201

DACITE (2B1) NORTH OF CINDER CONE, PISGAH CRATER WEATHERED



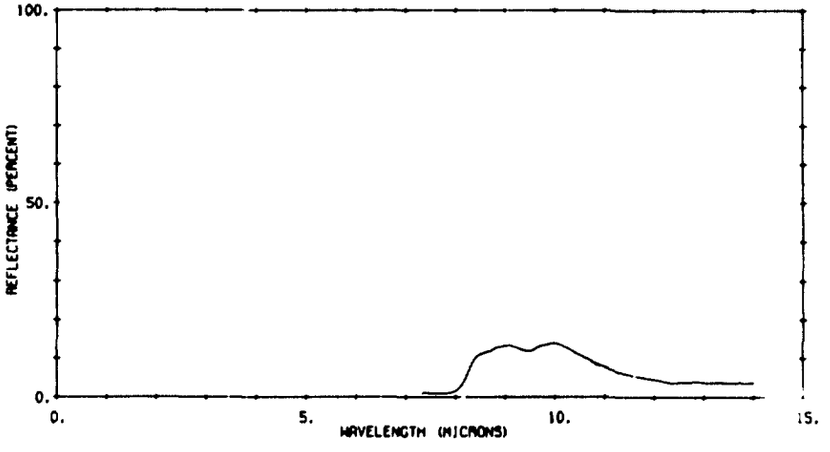
B09019 1

GRANITE (A79)



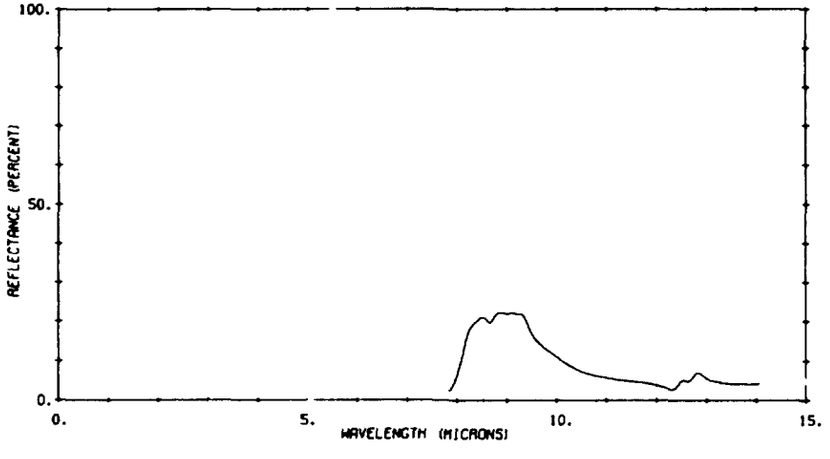
B09019 2

GRANITE (A119)



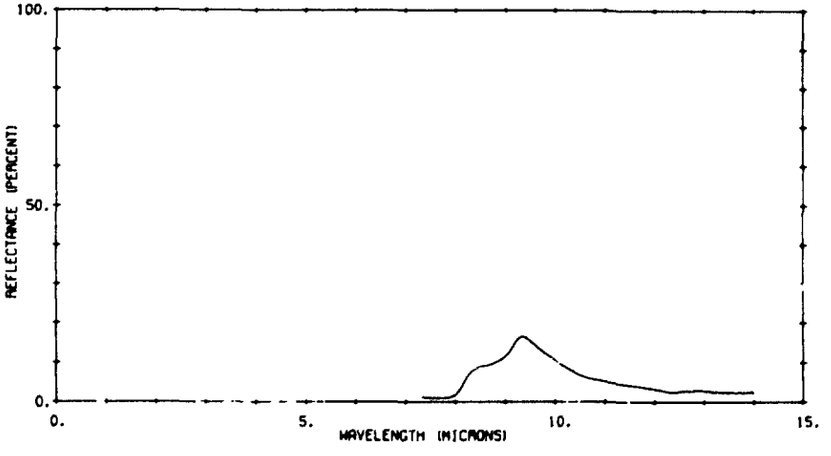
B09019 4

RHYOLITE (SA-49)



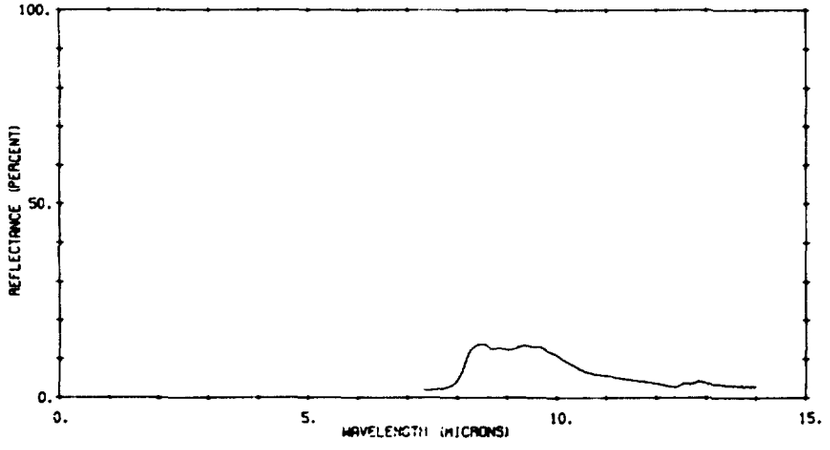
B09019 5

RHYOLITE (WELDED TUFF)



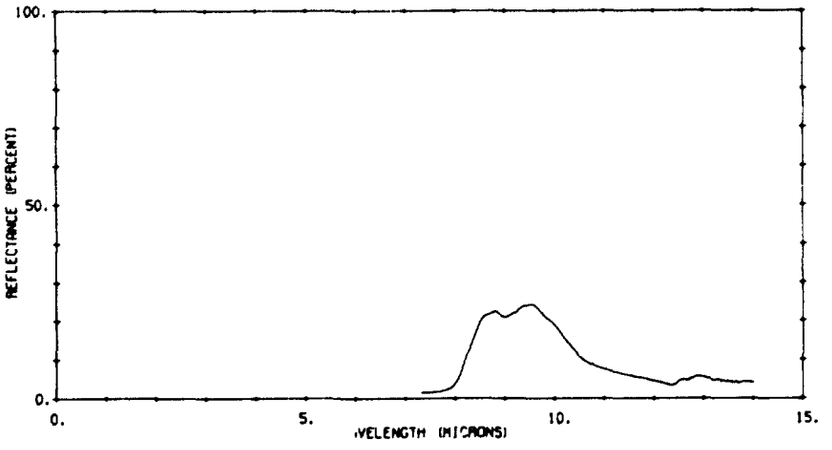
B09019 11

DACITE (E12A)



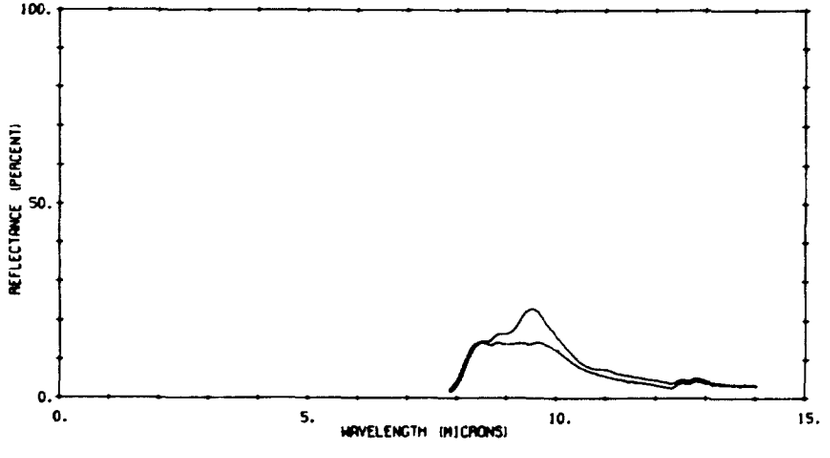
B09019 17

RHYODACITE (2A3)



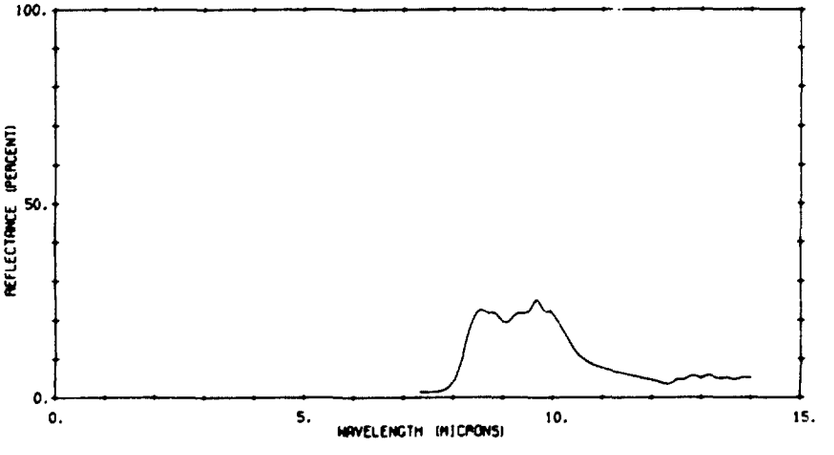
B09019 013

MONZONITE (2B5) FRESH (1), WEATHERED (2)



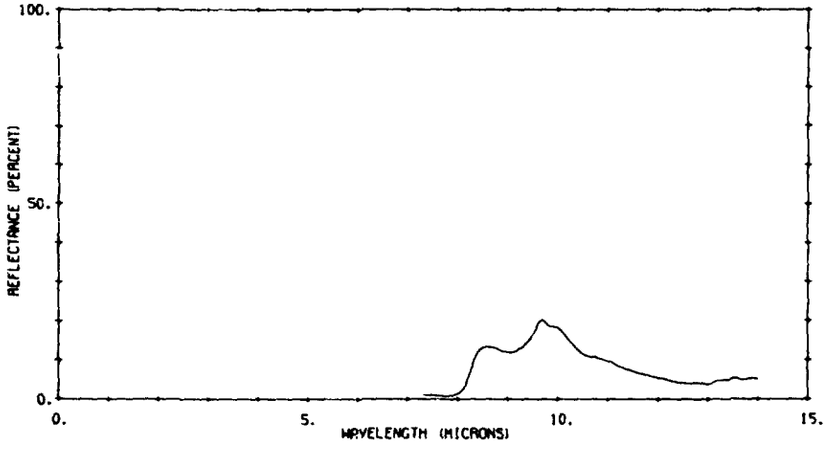
B09019 7

TRACHYTE



B09019 3

GRANITE (A122)



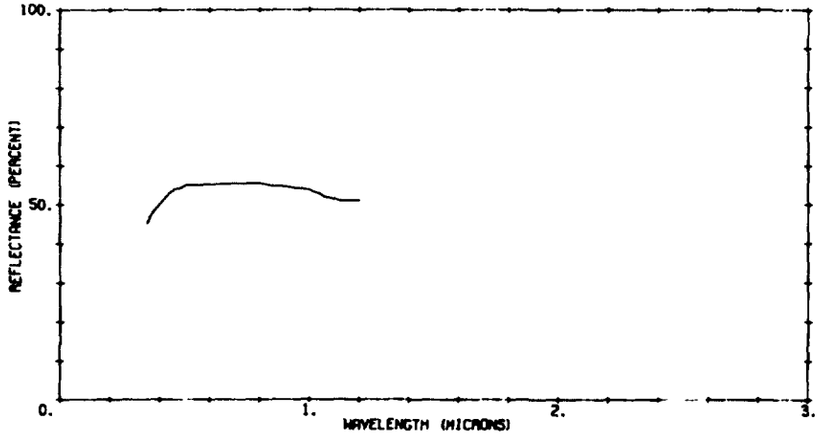
102

INTERMEDIATE SILICATE ROCKS

(Generally 53% to 65% SiO_2)

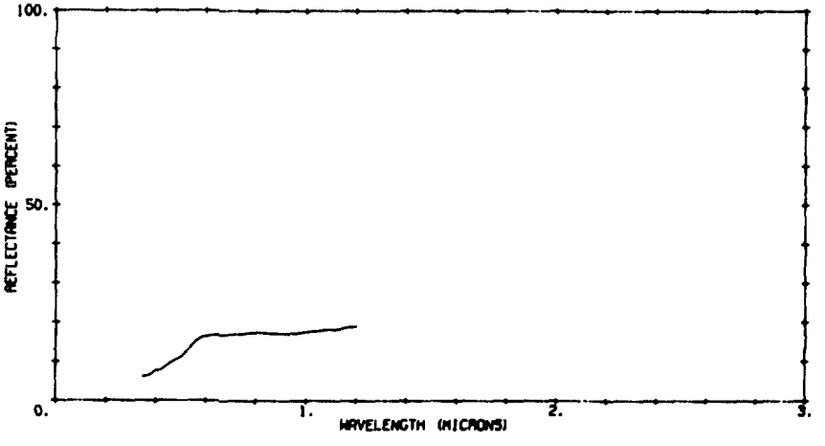
A09029 101

SYENITE TO SYENOGRANITE (2A6) PISGAH SAMPLE FRESH



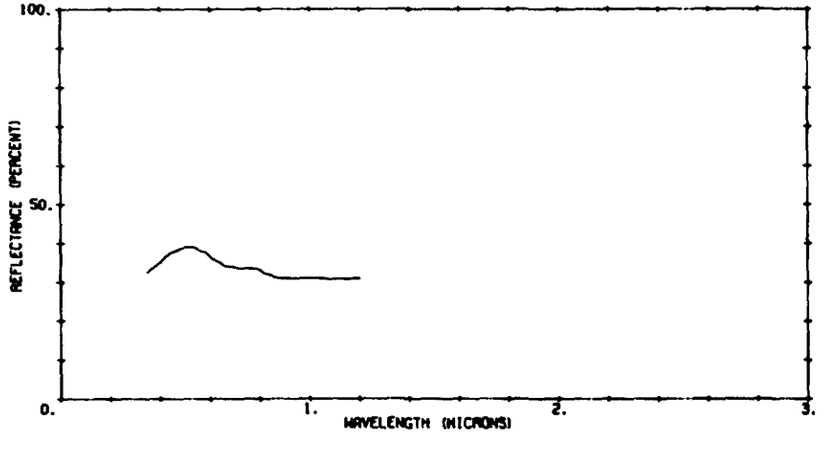
A09029 201

SYENITE TO SYENOGRANITE (2A6) PISGAH SAMPLE WEATHERED.



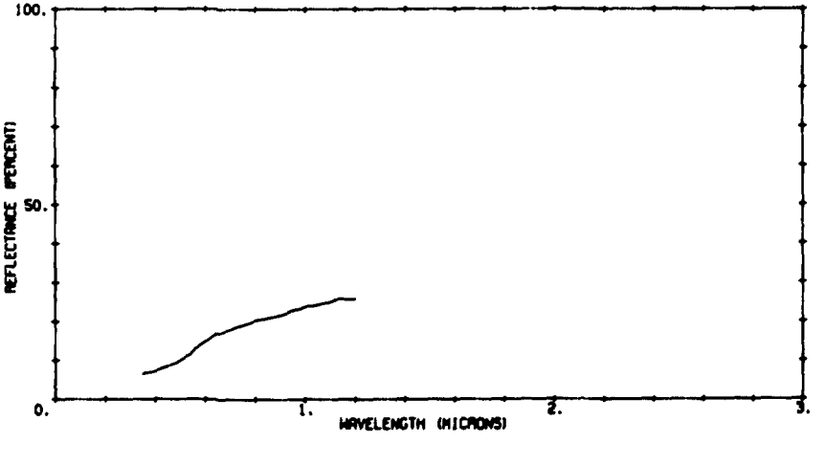
A09023 101

MONZODIORITE PORPHYRY (2A1) PISGAH SAMPLE FRESH



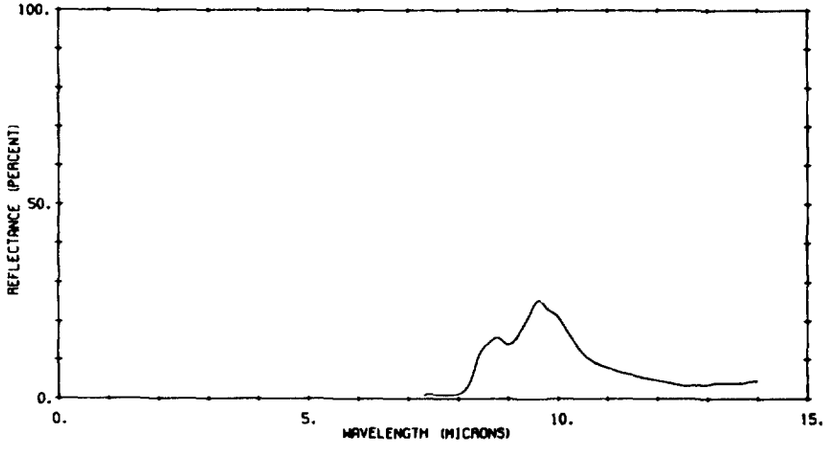
A09023 201

MONZODIORITE PORPHYRY (2A1) PISGAH SAMPLE WEATHERED.



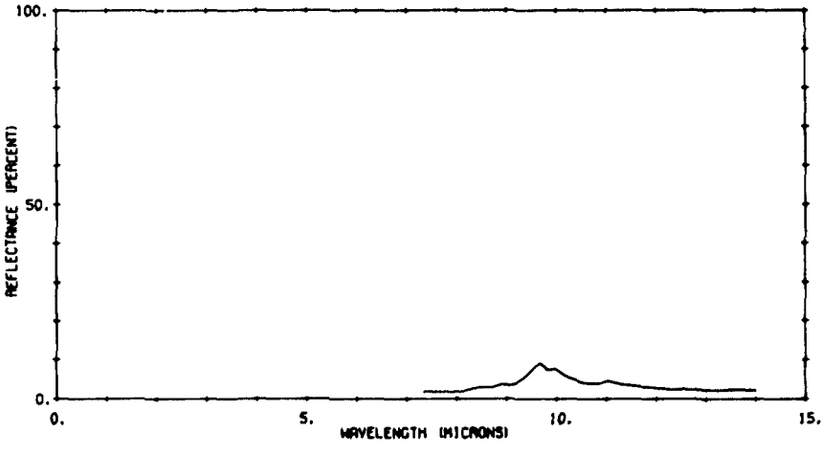
B09019 6

SYENITE (E83A)



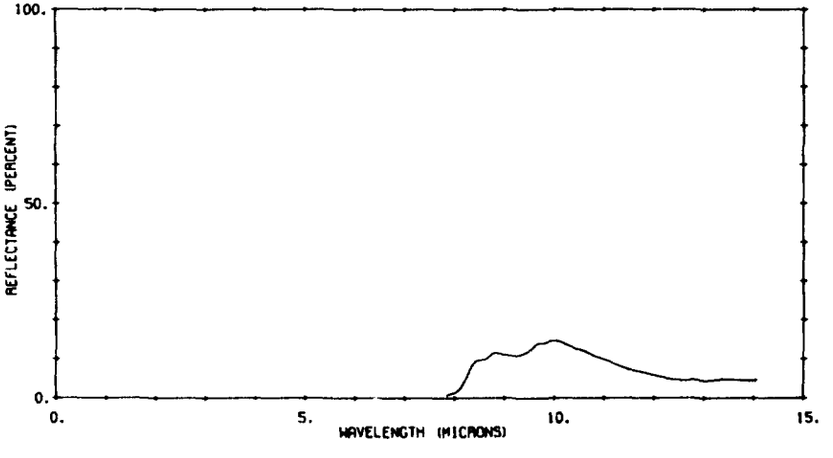
B09019 8

NEPHELINE SYENITE



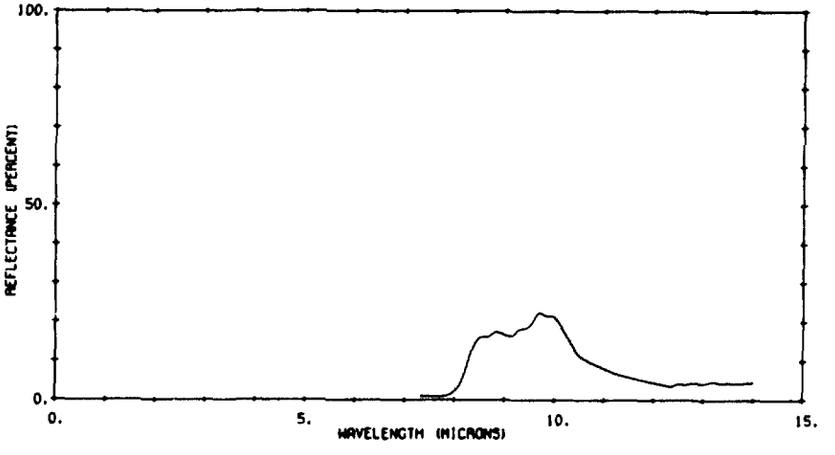
B09019 9

GRANODIORITE (A117)



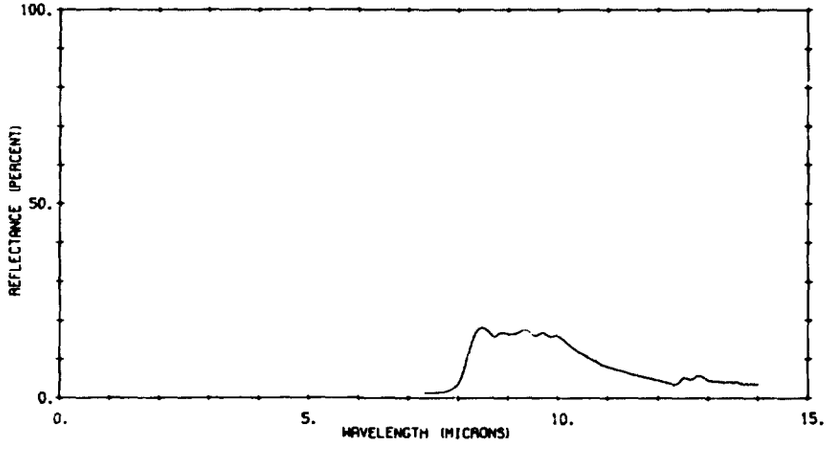
B09019 10

GRANODIORITE (A127)



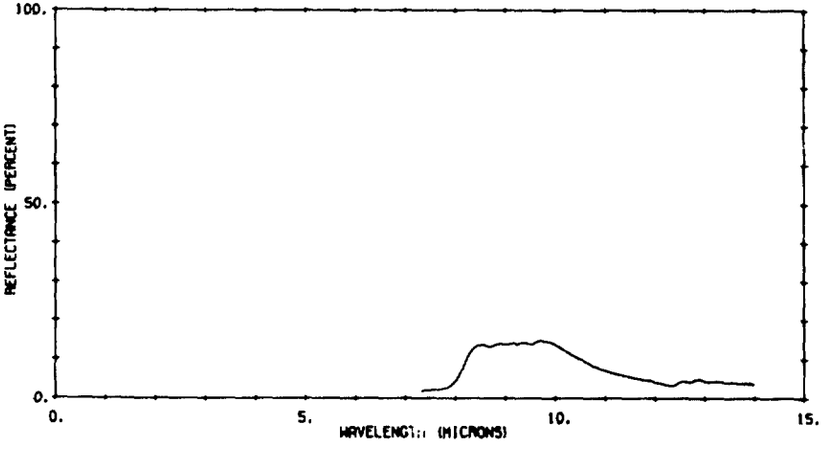
B09019 14

DIORITE (A129)



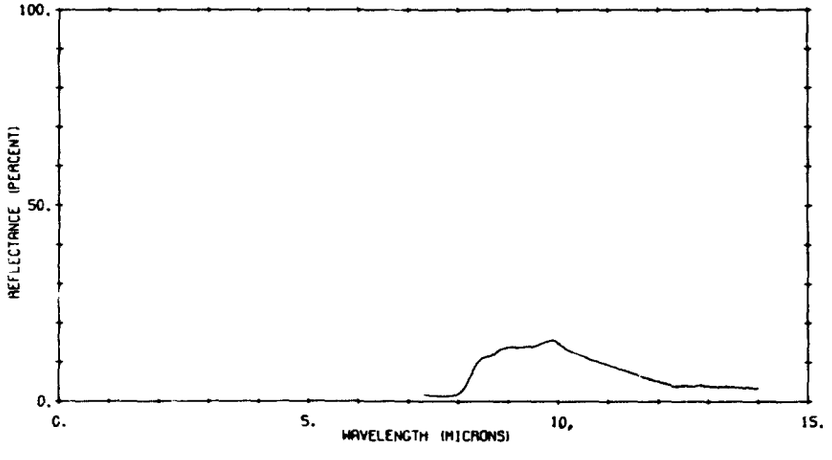
B09019 15

DIORITE (E47C)



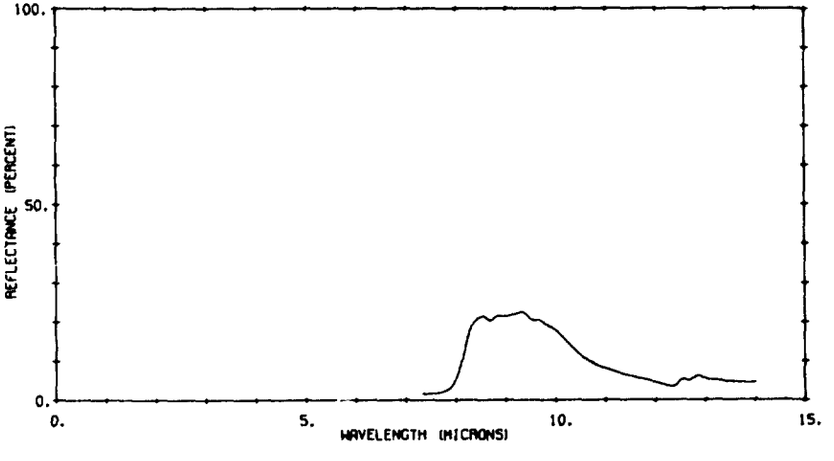
B09019 16

ANDESITE (E55A)



B09019 12

MONZODIORITE PORPHYRY (2A1)



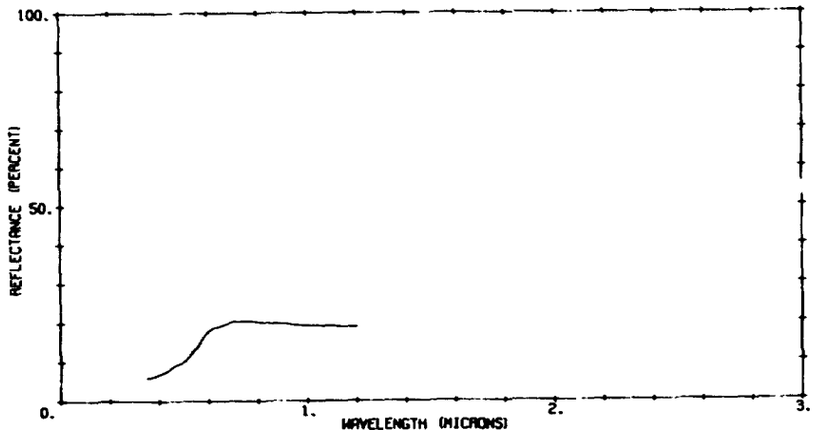
103

BASIC AND ULTRABASIC SILICATE ROCKS

(Generally less than 53% SiO_2)

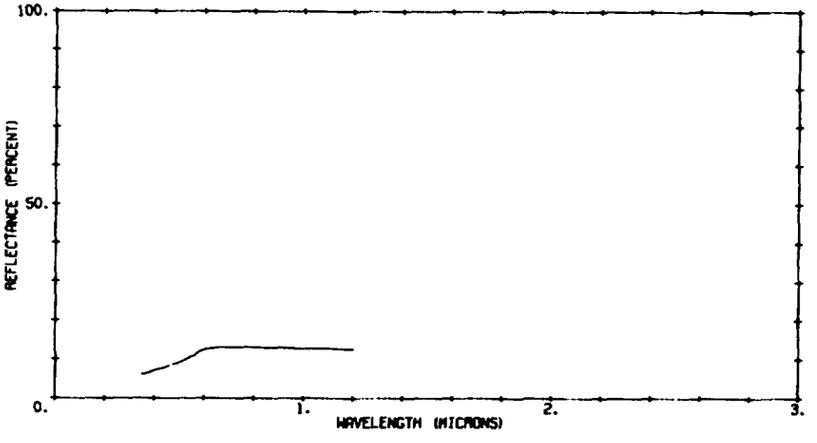
A09001 101

BASALT PHASE 3 PISGAH LAVA (PAHOEHOE) BOTTOM SURFACE FRESH.



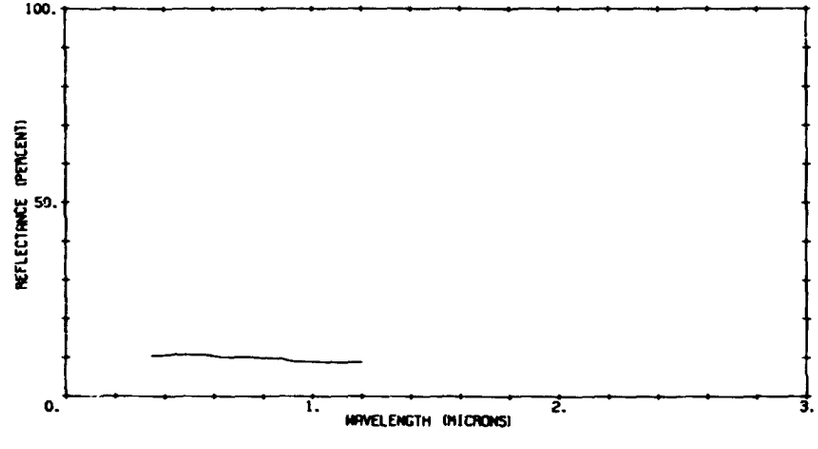
A09001 201

BASALT PHASE 3 PISGAH LAVA (PAHOEHOE) TOP SURFACE WEATHERED.



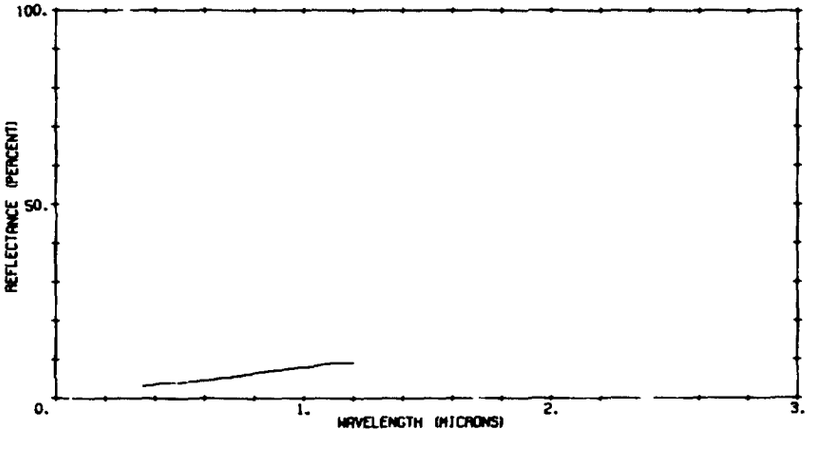
A09002 101

BASALT PHASE 2 PISGAH (1A2) TOP SURFACE VERTICAL SURFACE.



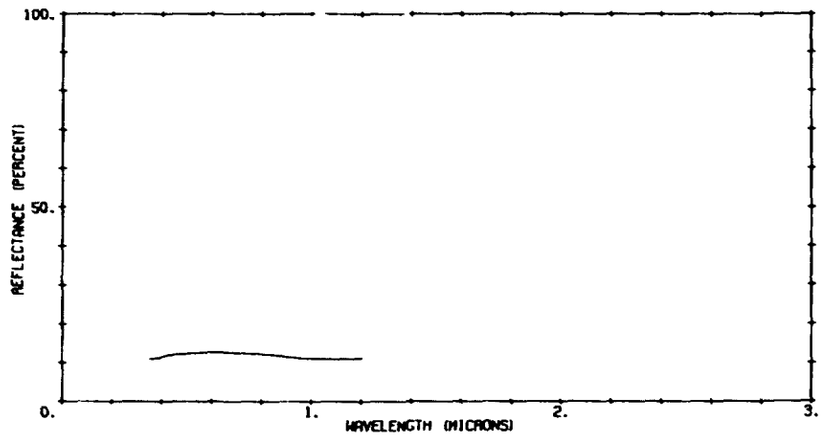
A09002 201

BASALT PHASE 2 PISGAH (1A2) BOTTOM SURFACE.



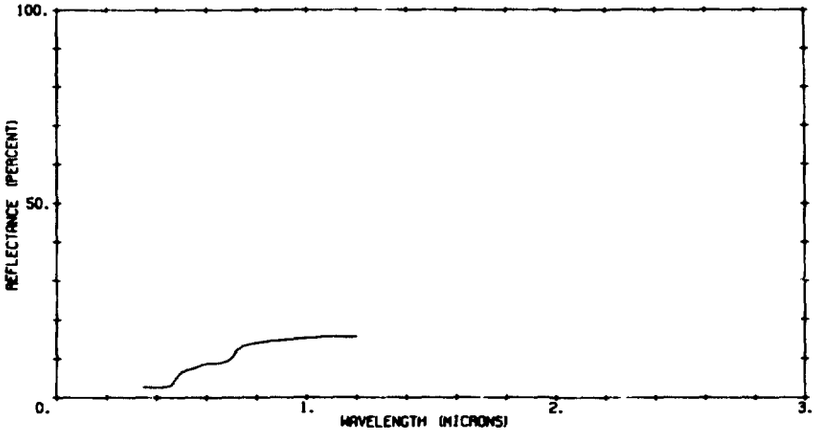
A09003 101

BASALT PHASE 2 PISGAH (1A2) BOTTOM SURFACE.



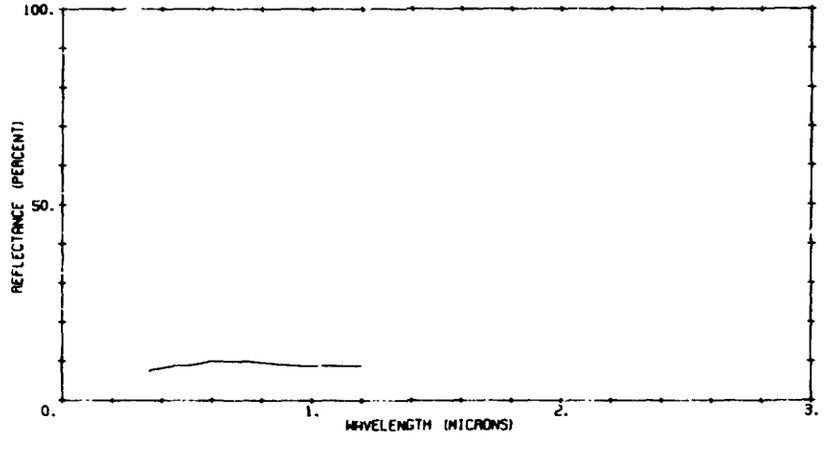
A09003 201

BASALT PHASE 2 WITH LICHENS PISGAH CRATER (1A2) TOP SURFACE



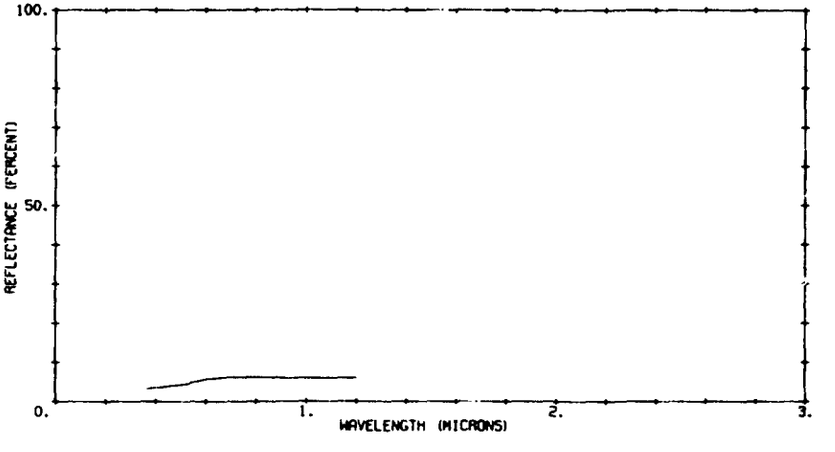
A09004 101

BASALT PHASE 3 (AA) (1A3) PISGAH BASALT SILT COVERED BOTTOM.



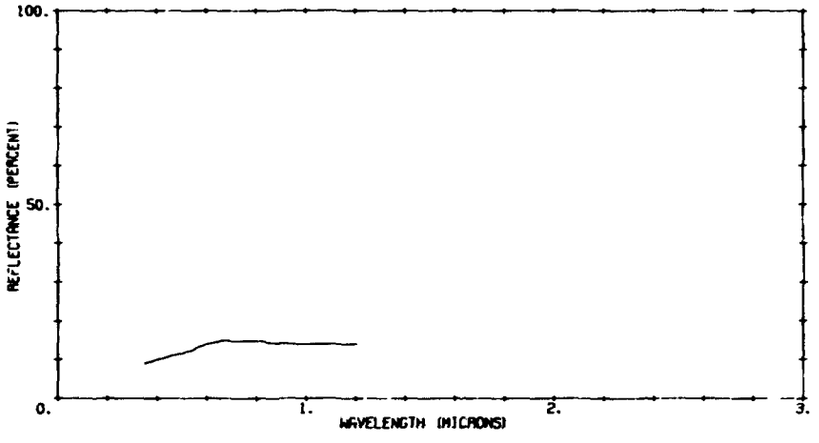
A09004 201

BASALT PHASE 3 (AA) (1A3) PISGAH BASALT SILT COVERED TO



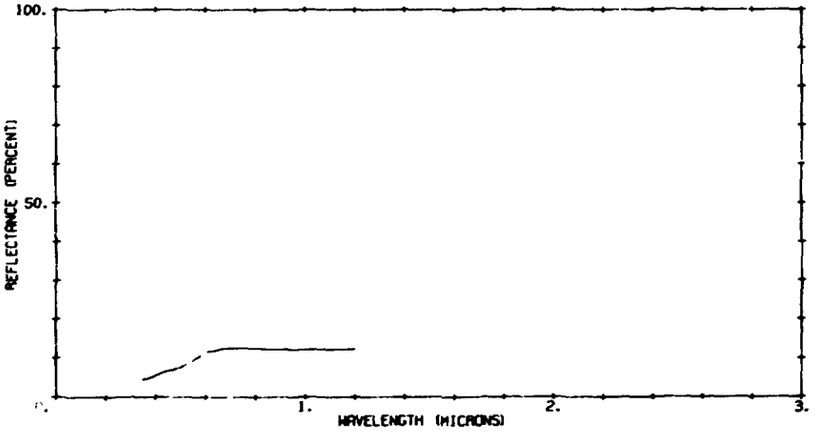
A09005 101

BASALT (PAHOEHOE) ON ALLUVIUM (1A4) BOTTOM SURFACE



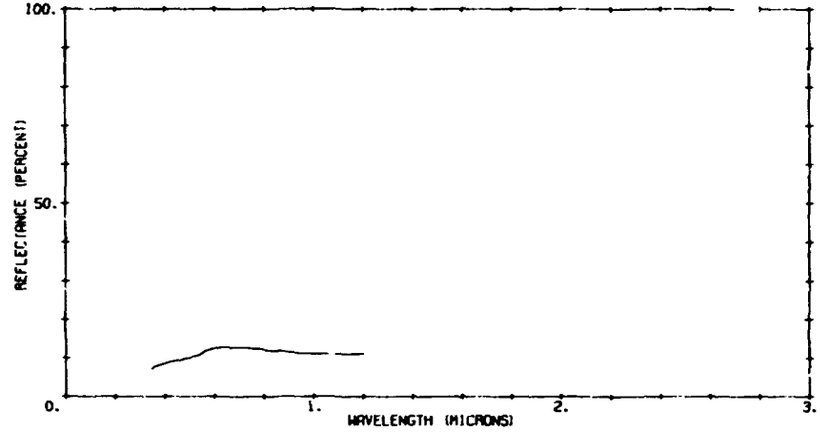
A09005 201

BASALT (PAHOEHOE) ON ALLUVIUM (1A4) TOP SURFACE



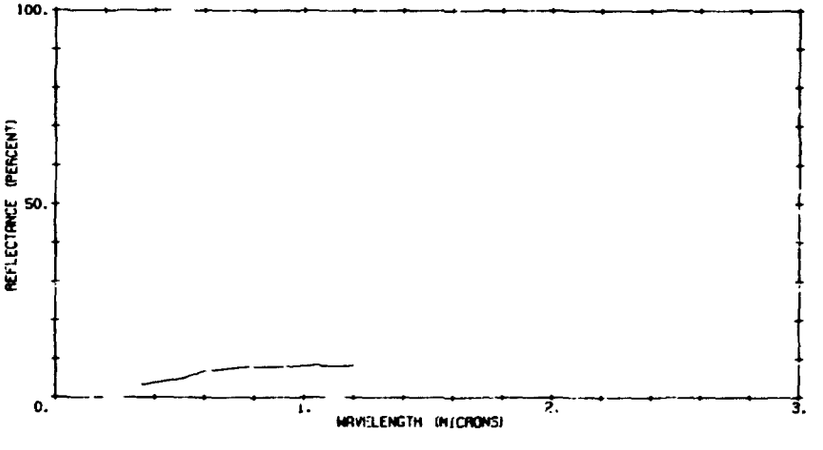
A09007 101

BASALT (AA) TOP OF PENINSULA (1A6S) FRESH.



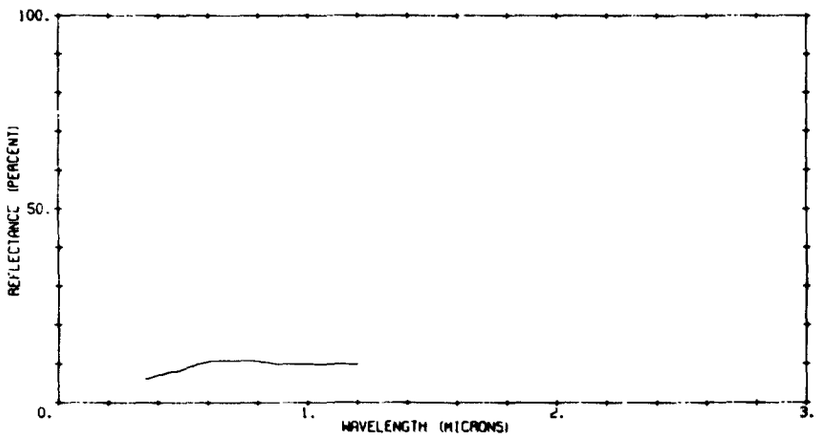
A09007 201

BASALT (AA) TOP OF PENINSULA (1A6S) WEATHERED



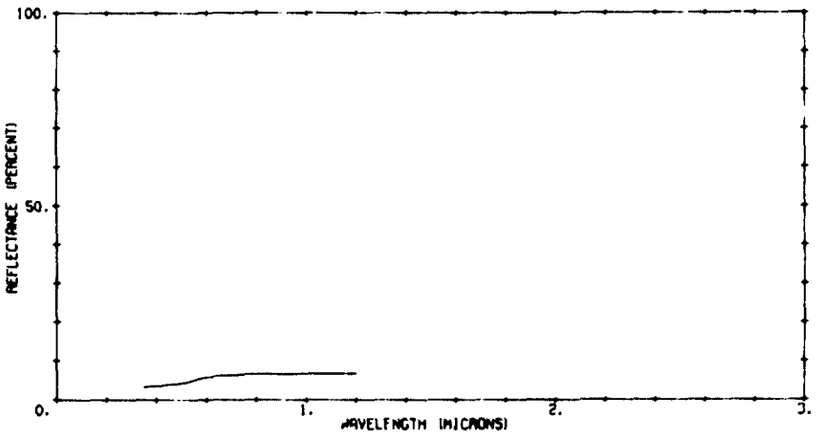
A09008 101

BASALT PHASE 1 PISGAH LAVA (AA) BOTTOM SURFACE (SILTY)



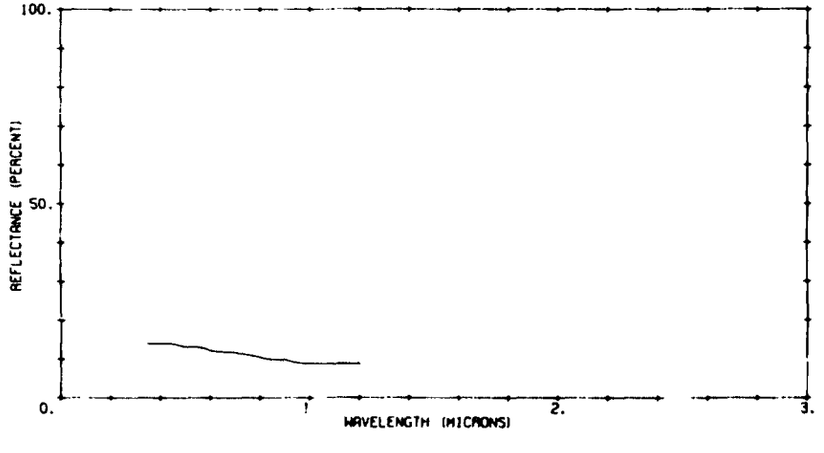
A09008 201

BASALT PHASE 1 PISGAH LAVA (AA) TOP SURFACE (1A7).



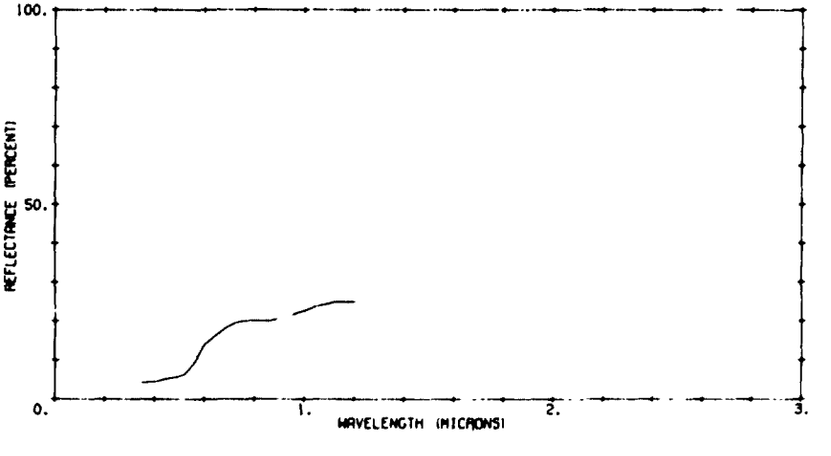
A09009 101

BASALT PHASE 1 PISGAH L ' (LAVA TUBE) BOTTOM SURFACE SILTY
(1A8)



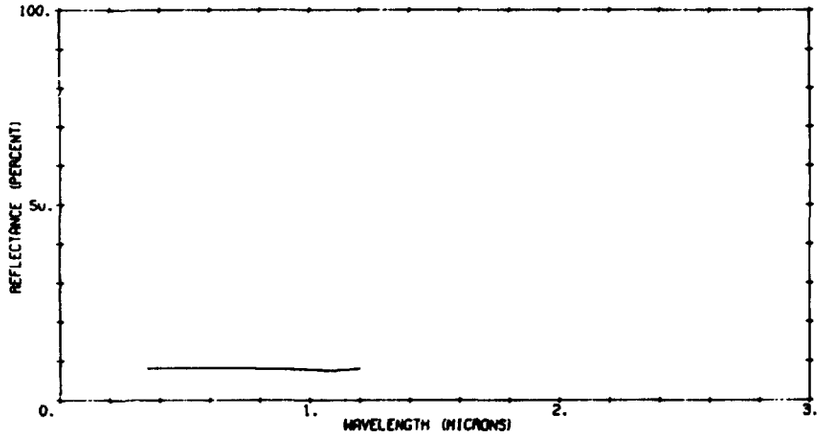
A09009 201

BASALT PHASE 1 PISGAH LAVA (LAVA TUBE) TOP SURFACE (1A8)



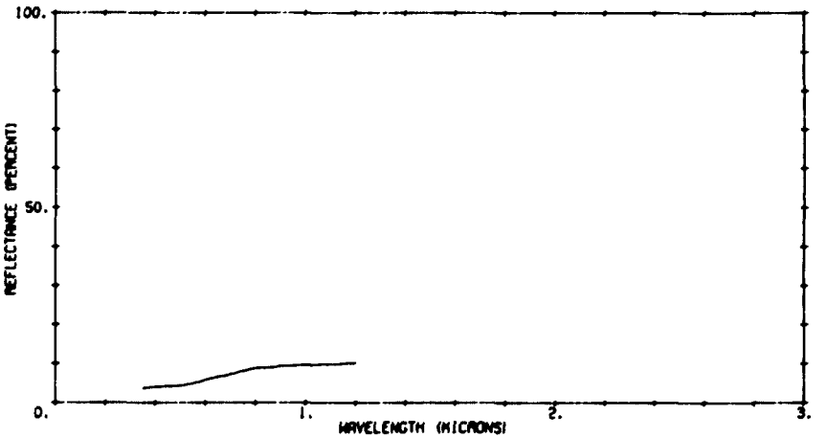
A09010 101

BASALT PHASE 1 PISGAH LAVA (AA) BOTTOM SURFACE (1A9).



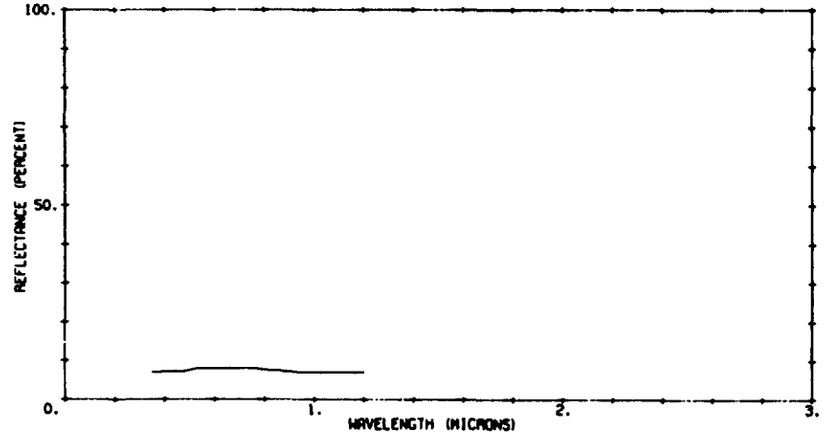
A09010 201

BASALT PHASE 1 PISGAH LAVA (AA) TOP SURFACE (1A9).



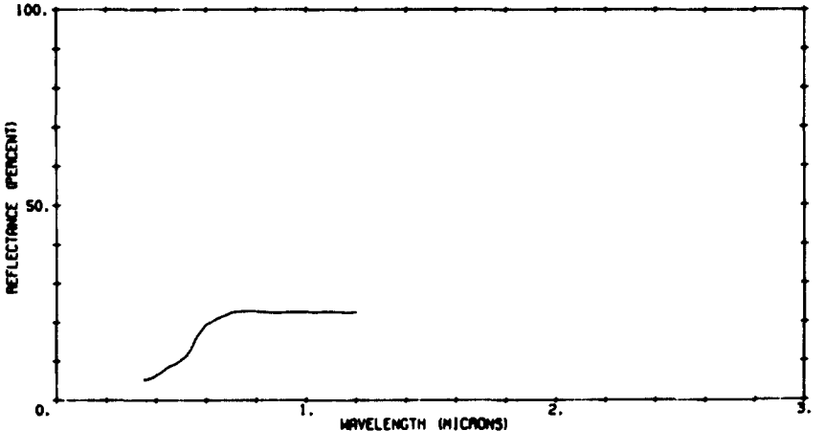
A09011 201

BASALT PHASE 3 PISGAH LAVA (PAHOEHOE, PENINSULA ACROSS ROAD)
TOP SURFACE (1A10).



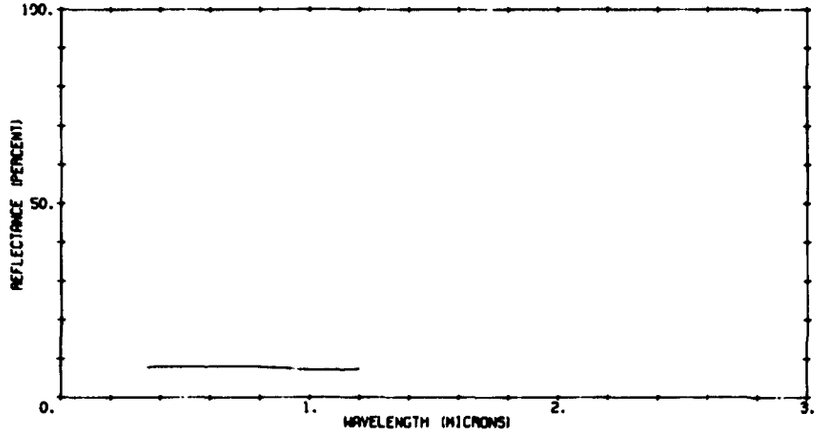
A09011 101

BASALT PHASE 3 PISGAH LAVA (PAHOEHOE, PENINSULA ACROSS ROAD)
BOTTOM SURFACE (SILTY) (1A10).



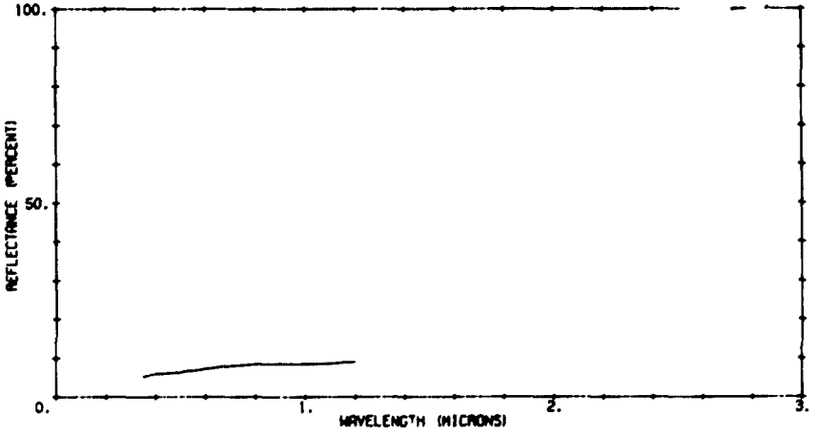
A09012 201

BASALT-PHASE 3 PISGAH LAVA (PAHOEHOE, PENINSULA ACROSS ROAD)
TOP SURFACE (1 A11).



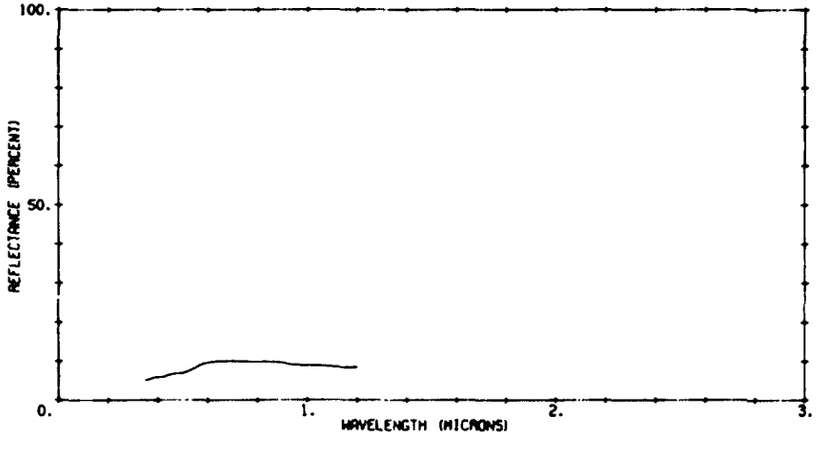
A09012 101

BASALT-PHASE 3 PISGAH LAVA (PAHOEHOE, PENINSULA ACROSS ROAD)
BOTTOM SURFACE (SILTY) (1A11)



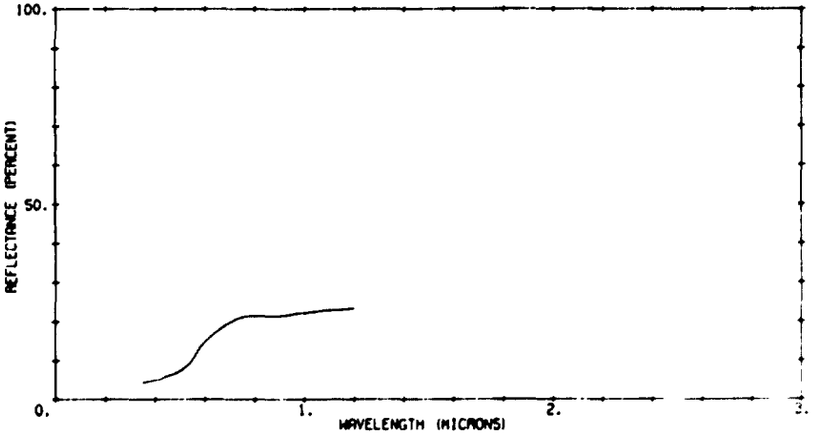
A09020 101

BASALT (AA) FROM EAST SIDE OF ROAD ADJACENT TO PENINSULA
(1A13) FRESH



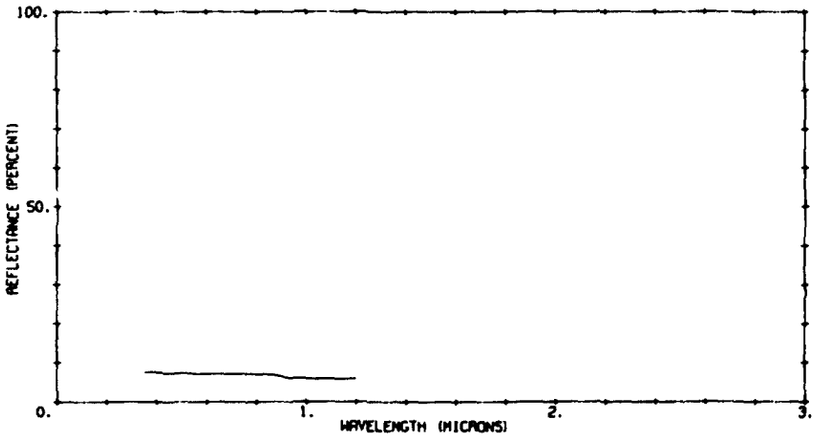
A09020 201

BASALT (AA) FROM EAST SIDE OF ROAD ADJACENT TO PENINSULA
(1A13) WEATHERED



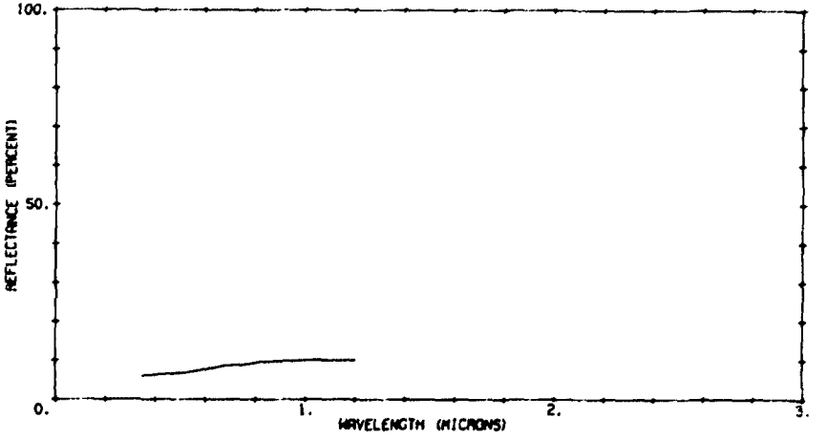
A09034 101

BASALT (2B2) NORTH OF CINDER CONE, CONTACT ZONE PISGAH FRESH



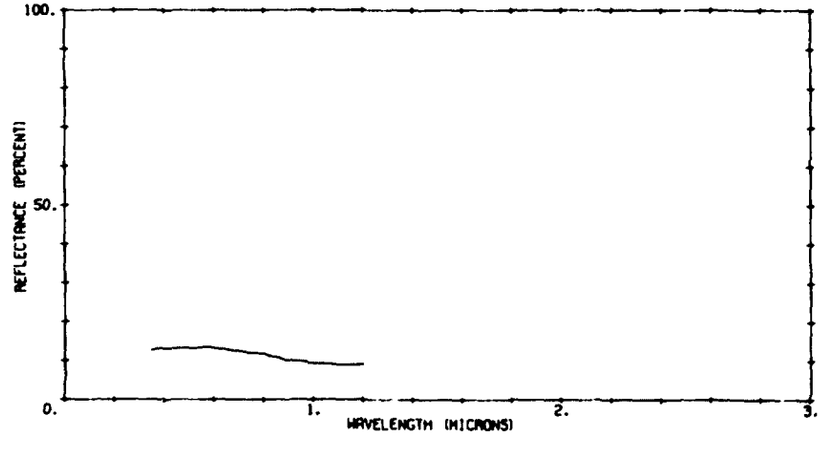
A09034 201

BASALT (2B2) NORTH OF CINDER CONE, CONTACT ZONE WEATHERED



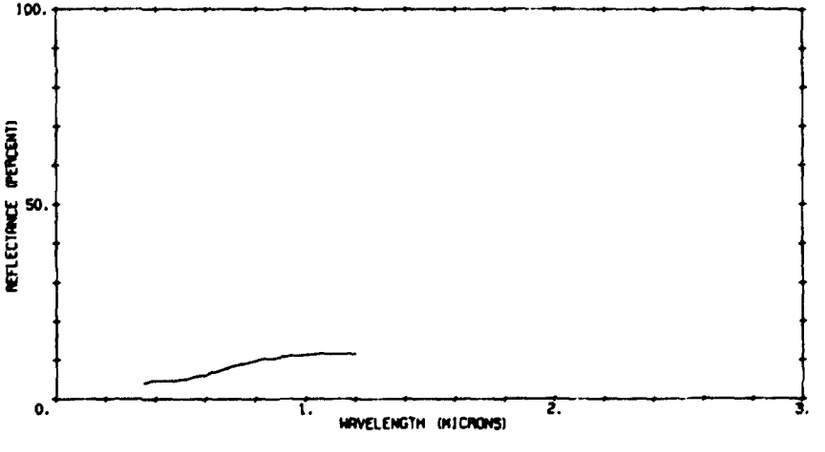
A09035 101

BASALT (2B3) FRESH SURFACE



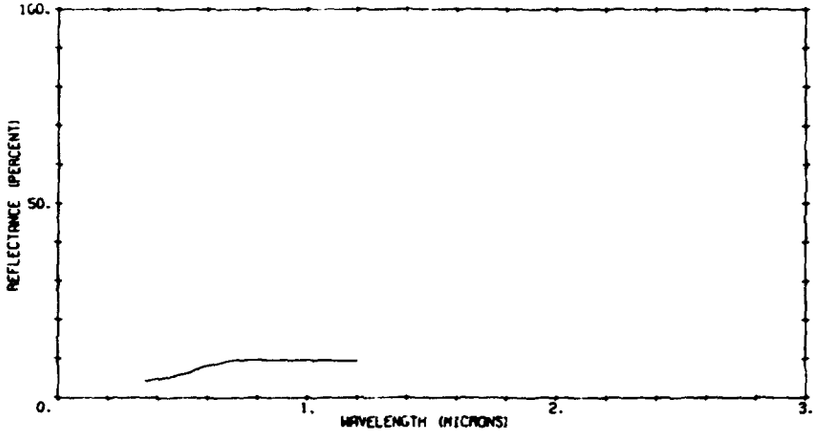
A09035 201

BASALT (2B3) WEATHERED SURFACE



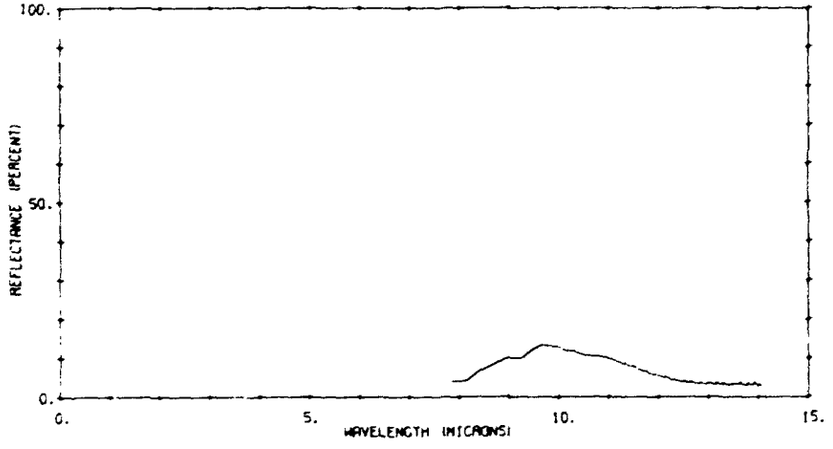
A09006 101

BASALT (PAHOEHOE) ON SAND (1A5) TOP SURFACE



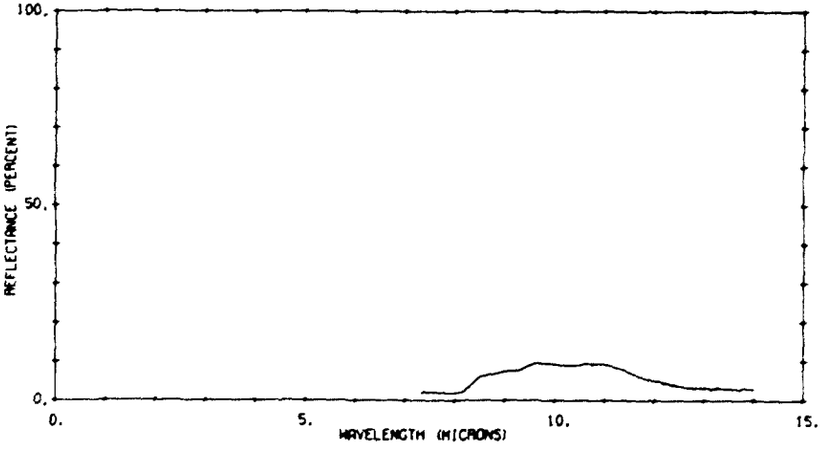
B09019 19

BASALT (1A8)



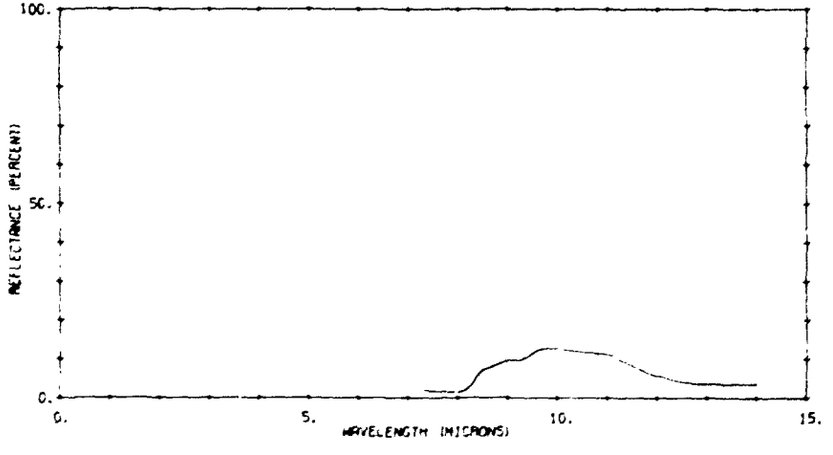
B09019 20

BASALT (WI-1-108)



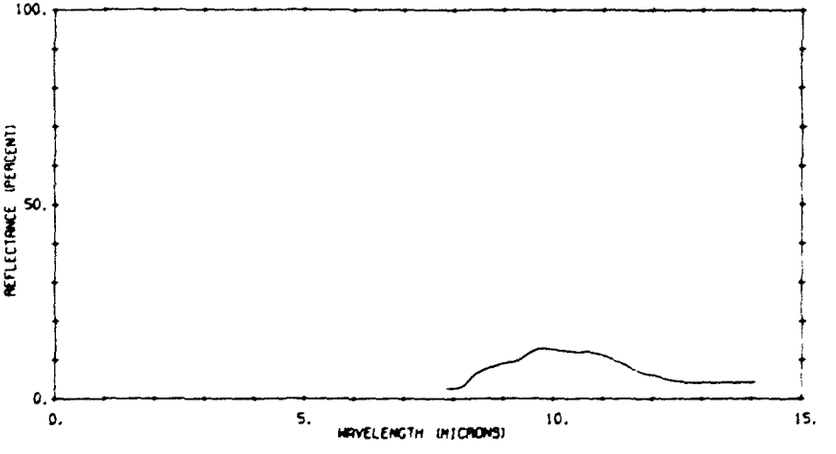
B09019 21

BASALT (595)



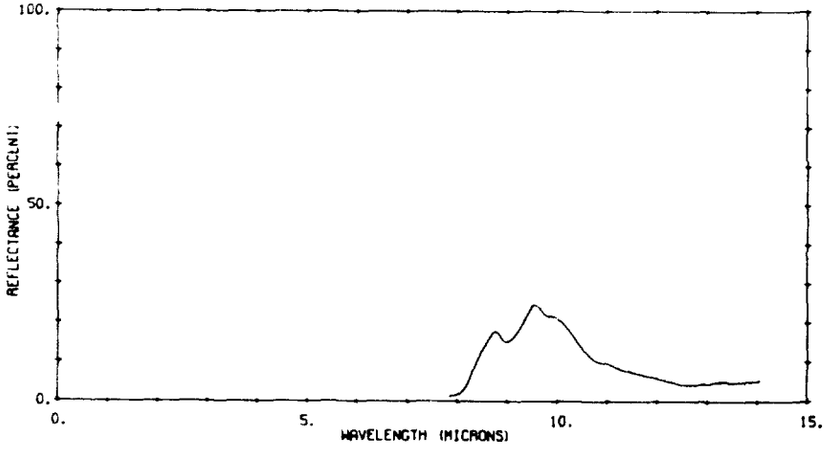
B09019 22

BASALT (5B4)



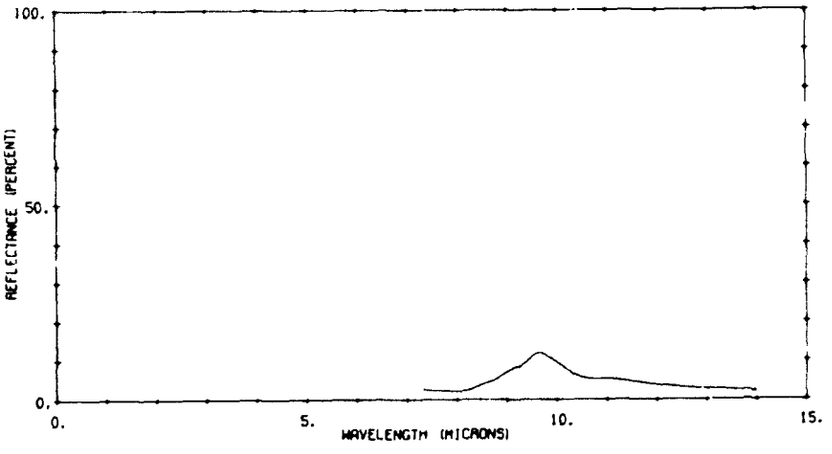
809019 18

GABBRO (E80A)



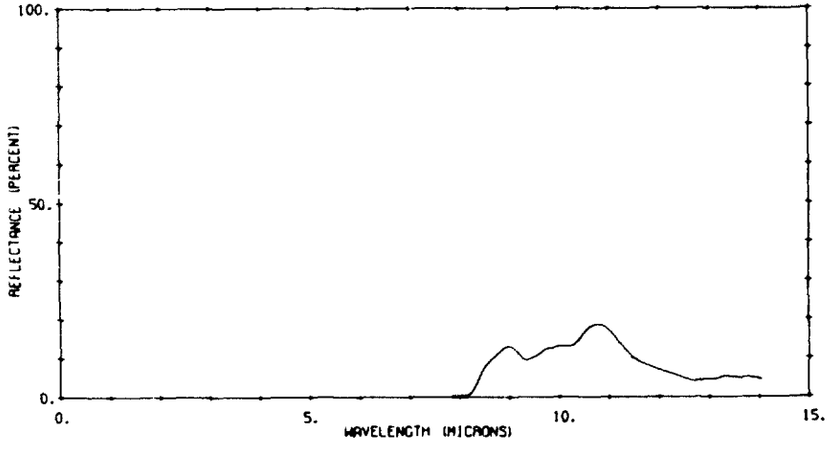
809019 23

BASALT (1A3)



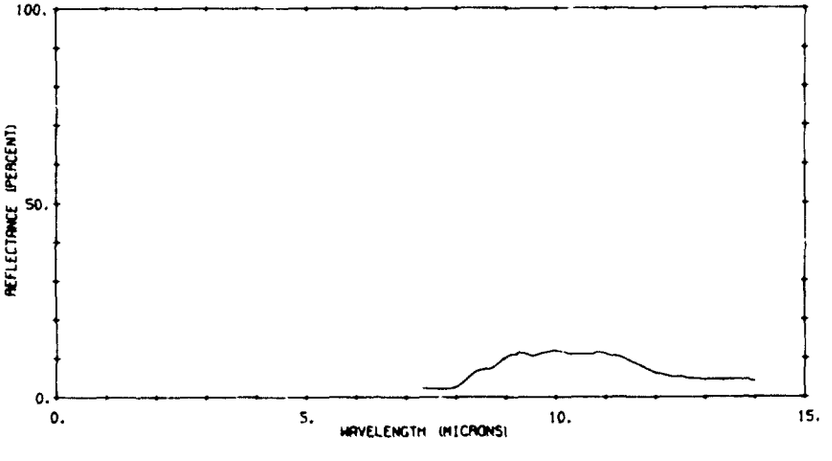
809019 24

ANORTHOSITE



809019 25

DIABASE



Appendix I
SUMMARY OF EXPERIMENTS YIELDING OPTICAL DATA

Each data curve published in this report has an identification number consisting of nine characters. The first character (prefix) is an alphabetic symbol, while the remaining eight are numeric. The alphabetic symbol is used to designate the original source of the data as well as 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 Willow Run Laboratories. The next five digits designate a specific sample registered at ERIM for which a complete sample description is maintained on file. The last three digits identify a particular area of the sample or a particular condition of measurement. Thus, for all measurements coordinated under WRL laboratory investigations, any successive measurements of the same sample are linked together by identification number regardless of the types of measurement made.

The symbol B, used as a prefix to the identification number, identifies either data taken from reports kept on file at ERIM or data obtained prior to establishment of the sample registration system. In both cases, the first five digits identify the document from which the data were taken.

Source documents from which the optical data have been extracted are briefly summarized below 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, as well as additional references describing some of the instrumentation in greater detail. Bibliographical information on each of the documents is stated; if more detailed information is required, the user is referred to the original source.

B 09007 Rohde, W. G. (and Olson, C. E., Jr.): Reflectance and Emittance Properties of Several Trees Species Subjected to Moisture Stress, Master's Thesis in the Department of Natural Resources, Dr. C. E. Olson, advisor, The University of Michigan, Ann Arbor, Michigan, April 30, 1971.

Platform: laboratory

Instrument: Cary 14

Quantity measured: directional reflectance (%)

Wavelength range: 0.5 to 2.6 μm

Reflectance attachment: integrating sphere

Reflectance standard: MgO

Comments: The data from a water stress study on the upper surfaces of red oak leaves over a period of several months are included in the Second Supplement to ERSIS.

B09019. Wagner, T., et al.: Tunnel-Site Selection by Remote Sensing Techniques. Willow Run Laboratories Michigan Technical Report No. 10018-13-F. U.S. Bureau of Mines Contract H0210041 (Final Report). The University of Michigan, Ann Arbor, Michigan, September, 1972.

Platform: laboratory (measured for WRL by Martin Marietta, Denver)

Instrument: Perkin-Elmer Model 98 monochromator with Gier Dunkle Parabolic Reflectometer

Quantity measured: directional reflectance (%)

Wavelength range: 7 to 14 μm

Reflectance standard: gold (polished)

Comments: This was part of a study to find better correlations between infrared spectral features and chemical and or mineralogical parameters of silicate rocks. Rock surfaces measured are those that would have been exposed to a multispectral scanner in the field. The granites have some crystal grains that are larger than the area observed (0.5 × 12 mm).

Source: Heated cavity source

Detector: High sensitivity radiation thermocouple

A090. Vincent, R. These are spectral measurements of geological samples from Pisgah Crater, California. They were collected in support of the ratio imaging investigation described in Refs. [7, 10, 11, 12].

Platform: laboratory (ERIM)

Instrument: Beckman Model DK-2

Quantity measured: directional reflectance (%)

Wavelength range: 0.35-1.2 μm

Reflectance standard: $BaSO_4$

Comments: Measurements were made of both exposed to scanner (termed "weathered") and fresh surfaces of most of the rock samples, all collected along the flight lines of a 1970 mission [7, 10] near Pisgah Crater, California.

Additional references: [10, 11, 12].

Appendix II

LIST OF RELATED REPORTS

The following reports describe remote sensing work performed by the Infrared and Optics Laboratory, Environmental Research Institute of Michigan, Ann Arbor (formerly known as Willow Run Laboratories before separation from The University of Michigan).

OPTICAL TRANSFER TECHNIQUES FOR ORBITAL SCANNERS, J. Braithwaite, E. Work, Report No. 31650-21-T, March 1971.

DETECTOR UTILIZATION IN LINE SCANNERS, L. Larsen, Report No. 31650-29-T, August 1971.

A PROTOTYPE HYBRID MULTISPECTRAL PROCESSOR (SPARC H) WITH HIGH THROUGHPUT CAPABILITY, F. Kriegler, R. Marshall, Report No. 31650-23-T, March 1971.

DATA DISPLAY REQUIREMENTS FOR A MULTISPECTRAL SCANNER PROCESSOR WITH HIGH THROUGHPUT CAPABILITY, R. E. Marshall, F. J. Kriegler, Report No. 31650-28-L, July 1971.

CALIBRATION OF MULTISPECTRAL SCANNERS, J. Braithwaite, Report No. 31650-27-L, September 1970.

STUDIES OF SPECTRAL DISCRIMINATION, W. A. Malila, et al., Report No. 31650-22-T, May 1971.

INVESTIGATIONS OF MULTISPECTRAL SENSING OF CROPS, R. Nalepka, et al., Report No. 31650-30-T, May 1971.

INVESTIGATION OF SHALLOW WATER FEATURES, F. Polcyn, et al., Report No. 31650-31-T, August 1971.

THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION, V. Leeman, et al., Report No. 31650-24-T, May 1971.

NASA MSC EARTH RESOURCES SPECTRAL INFORMATION SYSTEM PROCEDURES MANUAL, V. Leeman, et al., Report No. 31650-32-T, 1971.

DATA GAPS IN THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM, R. Vincent, Report No. 31650-25-T, March 1971.

REMOTE SENSING DATA ANALYSIS PROJECTS ASSOCIATED WITH THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM, R. Vincent, et al., Report No. 31650-26-T, April 1971.

INVESTIGATIONS RELATED TO MULTISPECTRAL IMAGING SYSTEMS FOR REMOTE SENSING, J. Erickson, Report No. 31650-17-P, September 1971.

INVESTIGATIONS RELATED TO MULTISPECTRAL IMAGING SYSTEMS (Final Report), J. Erickson, Report No. 31650-18-F, 1972.

NASA MSC EARTH RESOURCES SPECTRAL INFORMATION SYSTEM PROCEDURES MANUAL, SUPPLEMENT, V. Leeman, Report No. 31650-72-T, September 1971.

ESTIMATING PROPORTIONS OF OBJECTS FROM MULTISPECTRAL DATA, R. Nalepka, et al., Report No. 31650-73-T, 1972.

INFORMATION EXTRACTION TECHNIQUES, W. Malila, et al., Report No. 31650-74-T, 1972.

DISCRIMINATION TECHNIQUES EMPLOYING BOTH REFLECTIVE AND THERMAL MULTISPECTRAL SIGNALS, W. Malila, Report No. 31650-75-T, 1972.

ROCK-TYPE DISCRIMINATION FROM RATIO IMAGES OF THE PISGAH CRATER, CALIFORNIA TEST SITE, R. Vincent, et al., Report No. 31650-77-T, 1972.

INVESTIGATION OF THEORETICAL METHODS FOR THE OPTICAL MODELING OF AGRICULTURAL FIELDS AND ROUGH-TEXTURED ROCK AND MINERAL SURFACES, R. Vincent, et al., Report No. 31650-78-T [in publication].

NEW THEORETICAL MODELS AND RATIO IMAGING TECHNIQUES ASSOCIATED WITH THE NASA RESOURCES SPECTRAL INFORMATION SYSTEM, R. Vincent, et al., Report No. 31650-153-T [in publication].

REFERENCES

1. Leeman, V., et al., NASA Earth Resources Spectral Information System: A Data Compilation, Report No. 31650-24-T, Willow Run Laboratories, Institute of Science and Technology, The University of Michigan, Ann Arbor, May 1971.
2. Leeman, V., NASA Earth Resources Spectral Information System: A Data Compilation, First Supplement, Report No. 31650-69-T, Willow Run Laboratories, Institute of Science and Technology, The University of Michigan, Ann Arbor, March 1972.
3. Vincent, R., Data Gaps in the NASA Earth Resources Spectral Information System, Report No. 31650-25-T, Willow Run Laboratories, Institute of Science and Technology, The University of Michigan, Ann Arbor, March 1971.
4. Vincent, R., et al., Remote Sensing Data Analysis Projects Associated with the NASA Earth Resources Spectral Information System, Report No. 31650-26-T, Willow Run Laboratories, Institute of Science and Technology, The University of Michigan, Ann Arbor, April 1971.
5. Leeman, V., et al., NASA/MSC Earth Resources Spectral Information System Procedures Manual, Report No. 31650-32-T, Willow Run Laboratories, Institute of Science and Technology, The University of Michigan, Ann Arbor, 1971.
6. Leeman, V., NASA/MSC Earth Resources Spectral Information System Procedures Manual, Supplement, Report No. 31650-72-T, Willow Run Laboratories, Institute of Science and Technology, The University of Michigan, Ann Arbor, September 1971.
7. Vincent, R., Rock-Type Discrimination from Ratio Images of the Pisgah Crater, California Test Site, Report No. 31650-77-T, Willow Run Laboratories, Institute of Science and Technology, The University of Michigan, Ann Arbor, 1972.
8. Vincent, R., et al., Investigation of Theoretical Methods for the Optical Modeling of Agricultural Fields and Rough-Textured Rocks and Mineral Surfaces, Report No. 31650-78-T, Willow Run Laboratories, Institute of Science and Technology, The University of Michigan, Ann Arbor, 1972.
9. Vincent, R., et al., New Theoretical Models and Ratio Imaging Techniques Associated with the NASA Earth Resources Spectral Information System, Report No. 31650-153-T, Environmental Research Institute of Michigan, Ann Arbor [in publication].
10. Vincent, R., and F. J. Thomson, Rock-Type Discrimination from Ratioed Infrared Scanner Images of Pisgah Crater, California, Science, Vol. 175, 3 March 1972, pp. 986-988.
11. Vincent, R., and F. J. Thomson, Spectral Compositional Imaging of Silicate Rocks, JGR, Vol. 77, No. 14, 10 May 1972, pp. 2465-2472.
12. Vincent, R., et al., Remote Sensing Data-Analysis Projects Associated with the NASA Earth Resources Spectral Information System, The University of Michigan Technical Report 31650-26-T, NASA Contract NAS 9-9784, 1971.