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**THE NASA EARTH RESOURCES SPECTRAL INFORMATION
SYSTEM: A DATA COMPILATION**

Second Supplement

by

**R. K. Vincent
Infrared and Optics Division**



prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

**Lyndon B. Johnson Space Center
Contract NAS 9-9784**

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Lyndon B. Johnson Space Center
Houston, Texas 77058

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.

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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.



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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)	BFIN	Dublin (3)
BEA	Flat (21)	BFIO	Gooch (3)
BEB	Rolling	BFIP	Grady (3)
BEC	Hilly (4)	BFIQ	Greenville (4)
BED	Mountainous (38)	BFIR	Gauthrie (2)
BEE	Rural (112)	BFIS	Hainamanu (1)
BEF	Urban	BFIT	Hall (2)
BF	Soil (90)	BFIU	Hamakua (2)
BFA	Cultivated (27)	BFIV	Herradura (2)
BFB	Uncultivated	BFIW	Joplin (2)
BFC	Coarse Textured	BFIX	Marias (2)
BFCA	Sand (122)	BFIY	Marshall (2)
BFCB	Loamy Sand (6)	BFIZ	Matanzas (2)
BFD	Moderately Coarse Textured (1)	BFJ	Series (Continued)
BFDA	Sandy Loam (30)	BFJA	Maury (3)
BFDB	Fine Sandy Loam (20)	BFJB	Moaula (4)
BFE	Medium Textured	BFJC	Naalehu (4)
BFEA	Loam (28)	BFJD	Onomea (2)
BFEB	Silt Loam (25)	BFJE	Ookala (4)
BFEC	Silt (3)	BFJF	Orangeburg (4)
BFF	Moderately Fine Textured	BFJG	Oriente (2)
BFFA	Clay Loam (22)	BFJH	Orman (2)
BFFB	Sandy Clay Loam	BFJI	Pallman
BFFC	Silty Clay Loam	BFJJ	Penn (2)
BFB	Fine Textured	BFJK	Pierre (2)
BFGA	Sandy Clay	BFJL	Putnam (2)
BFGB	Silty Clay	BFJM	Quibdo
BFGC	Clay (42)	BFJN	Rubicon (2)
BFH	Other Constituents (13)	BFJO	Ruston (8)
BFHA	Organic Material (3)	BFJP	Santa Barbara (4)
BFHB	Gravel (less than 3-in. diameter) (7)	BFJQ	Texas Dune (2)
BFHC	Cobbles (3- to 10-in. diameter) (6)	BFJR	Tifton (2)
BFHD	Stones (greater than 10-in. diameter) (10)	BFJS	Tillman (2)
BFHF	Salt (1)	BFJT	Tilsit (2)
BFI	Series	BFJU	Vernon (2)
BFIA	Aguan (2)	BFJV	Weld (4)
BFIB	Aiken (2)	BFJW	Windthorst (4)
BFIC	Akron (2)	BFJX	Yolo
BFID	Alamance (2)	BFJY	Zanesville (2)
BFIE	Albion (2)	BFK	Minerals (22)
BFIF	Alonso (2)	BFL	Chemicals (14)
BFIG	Barnes (3)	BH	Water (2)
BFIH	Blakely (4)	BHA	Formations (2)
BFII	Clareville (2)	BHAA	Lake (6)
BFIJ	Clarion (2)	BHAB	Puddle
BFIK	Collington (1)	BHAC	River (4)
BFIL	Colts Neck (9)	BHAD	Sea (12)
BFIM	Decatur (2)	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)	BGCMM	Selin (1)
BGA	Herbaceous, Algae Fungi	BGCMN	Timothy (9)
BGAA	Cladoniaceae Family (1)	BGCMO	Vetch (1)
BGAAA	Reindeer Moss (3)	BGCMP	Wheat (140)
BGB	Moss-Liverwort (6)	BGCN	Heath Family (5) (see also Ligneous)
BGBA	Sphagnum Family		European Blueberry
BGBAA	Sphagnum Moss (1)	BGCNA	Heather (1)
BGC	Vascular (5)	BGCNB	Mallow Family
BGCA	Banana Family (3)	BGCO	Cotton (121)
BGCAA	Banana	BGCOA	Mustard Family
BGCB	Bromeliaceae Family	BGCP	Cabbage (5)
BGCB A	Bunch Grass (1)	BGCPA	Mustard (1)
BGCC	Buckwheat Family	BGCPB	Nightshade Family
BGCCA	Buckwheat (1)	BGCQ	Potatoes (5)
BGCD	Composite Family (2) (cf. Ligneous)	BGCQA	Tomatoes (4)
	Daisy (3)	BGCQB	Pea (or Pulse) Family (3) (see also Ligneous)
BG CDA	Goldenrod (1)	BGCR	Alfalfa ()
BG CDB	Ragweed (3)	BGCRA	Clover (8)
BG CDC	Sunflower (1)	BGCRB	Coffee plant (1)
BG CDE	Convolvulus Family	BGCR C	Lentil (2)
BG CEA	Sweet Potato (1)	BGCRD	Lima Bean (3)
BG CF	Crowfoot Family	BGCRE	Pea (1)
BG CFA	Crowfoot (3)	BGCRF	Peanut (9)
BG CG	Duckweed Family	BGCRG	Soybean (158)
BG CGA	Duckweed (2)	BGCRH	String Bean (4)
BG CH	Evening-Primrose Family	BGCR I	Plantain Family
	Willow Herb (cf. Willow Family) (1)	BGCS	Plantain (?)
BG CI	Fern Family (3)	BGCSA	Sedge Family (1)
BG CIA	Bracken Fern (1)	BGCT	Cotton Grass (1)
BG CJ	Flax Family	BGCTA	Sedge (5)
BG CJA	Flax (5)	BGCTB	Ligneous (24)
BG CK	Goosefoot Family (3)	BGD	Arecaceae Family (7)
BG CKA	Pigweed (3)	BGDA	Areca Palm (3)
BG CKB	Sugar Beet (9)	BGDAA	Beech Family
BG CL	Gourd Family	BGDB	Beech (24)
BG CLA	Squash (3)	BGDBA	Chestnut (2)
BG CM	Grass Family (136)	BGDBB	Oak (160)
BG CMA	Barley (15)	BGDBC	Bignonia Family
BG CMB	Bermuda Grass (1)	BGDC	Catalpa (12)
BG CMC	Corn (188)	BGDCA	Dalycanthaceae Family
BG CMD	Creeping Grass (1)	BGDD	Meratia Praecox (2)
BG CME	Fescue (3)	BGDDA	Carduaceae Family
BG CMF	Foxtail (6)	BGDE	Rabbit Brush (1)
BG CMG	Ilyas (13)	BGDEA	Cashew Family
BG CMH	Millet (4)	BGDF	Chinese Pistachio (1)
BG CMI	Oats (15)	BGDF A	Sumach (2)
BG CMJ	Reeds (1)	BGDFB	Composite Family (2) (cf. Herbaceous)
BG CMK	Rice (5)	BGDG	Sagebrush (3)
BG CML	Rye (7)	BGDGA	Wormwood (3)
		BGDGB	

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

BGDH	Dogwood Family	BGDXE	Pine (211)
BGDHA	Dogwood (35)	BGDFX	Spruce (11)
BGDI	Ebony Family	BGDY	Plane-Tree Family
BGDIA	Ironwood (2) (cf. Hazel Family)	BGDYA	Sycamore (150)
	Persimmon (2)	BGDZ	Pea Family (5) (cf. Herbaceous)
BGDIB	Elm Family	BGDZA	Locust (4)
BGDJ	Elm (23)	BGE	Ligneous (continued)
BGDJA	Figwort Family (4)	BGEA	Rose Family (16)
BGDK	Paulowina (1)	BGEAA	Blackberry (1)
BGDKA	Hazel Family	BGEAB	Cherry (9)
BGDL	Alder (1)	BGEAC	Hawthorn (1)
BGDLA	Birch (23)	BGEAD	Juneberry (3)
BGDLB	Hazelnut (6)	BGEAE	Peach (10)
BGDLC	Hornbeam (1)	BGEAF	Pin Cherry (1)
BGDLD	Ironwood (cf. Ebony Family)	BGEAG	Plum (11)
BGDLE	Heath Family (12) (cf. Herbaceous)	BGEB	Sour Gum Family (2)
BGDM	Mountain Laurel (3)	BGEBB	Gum
BGDMA	Holly Family	BGEC	Trumpet-Creeper Family
BGDN	Holly (3)	BGECA	Calabash (1)
BGDNA	Honeysuckle Family (2)	BGED	Vine Family
BGDO	Viburnum	BGEDA	Virginia Creeper (3)
BGDOA	Laurel Family (5)	BGEE	Walnut Family (1)
BGDP	Laurel (2)	BGEEA	Hickory (5)
BCDPA	Sassafras (3)	BGEF	Willow Family (100)
BGDPB	Lily Family (2)	BGEFA	Aspen (36)
BGDQ	Yucca (1)	BGEFB	Poplar (113)
BGDQA	Linden Family	BGEFC	Willow (6) (cf. Evergreen Primrose Family)
BGDR	Basswood (54)	BGEFCA	Dwarf (2)
BGDRA	Linden (3)	BGEFCB	Ground (1)
BGDRB	Logania Family	BGEG	Witch Hazel Family
BGDS	Privet (2) (Ligustrum)	BGEGB	Sweet Gum (52)
BGDSA	Magnolia Family (2)	BGF	Leaf (138)
BGDT	Magnolia (4)	BGFA	Narrow (402)
BGDTA	Tulip (2)	BGFB	Broad (197)
BGDTB	Tulip Poplar (5)	BGFBA	Coriaceous (Leathery)
BGDTC	Maple Family (168)	BGFBB	Membraneous
BGDU	Maple	BGFBC	Lower Leaf Surface (478)
BGDUA	Mulberry Family (2)	BGFBD	Upper Leaf Surface (564)
BGDV	Rubber (10)	BGFC	Young (Spring) (89)
BGDVA	Olive Family (7)	BGFD	Mature (Summer) (56)
BGDW	Ash (58)	BGFE	Old (Fall) (114)
BGDWA	Pine Family (6)	BGFF	Dry (157)
BGDY	Cedar (8)	BGG	Bark (38)
BGDYA	Fir (11)	BGH	Twig (21)
BGDYB	Juniper (6)		
BGDYC	Larch (4)		
BGDYD			

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

40 Herbs (1)	44 Flowering weeds (22)
41 Crops (2)	44A Clover (8)
41A Vegetables (47)	50 Shrubs (44)
41A1 Soybeans (11)	51 Dogwood (35)
41A1A Soybean leaf, green (48)	60 Trees (7)
41A1B Soybean pods and stems (46)	61 Deciduous (49)
41A1C Soybean leaf, mature (11)	61A Nut trees (4)
41A1D Soybeans, flowering (30)	61A1 Hickory leaf (5)
41A1E Soybeans, seedling stage (12)	61A2 Hazelnut leaf (6)
41B Grains (17)	61A3 Nutree bark (2)
41B1 Barley (9)	61A4 Chestnut leaf (2)
41B1A Barley field, stubble (6)	61B Fruit trees (58)
41B2 Corn (23)	61B1 Plum fruit (3)
41B2A Corn leaf, green (47)	61B1A Plum leaf (7)
41B2B Corn leaf, brown (45)	61B1B Plum, bark and twig (5)
41B2C Corn leaf, yellow (15)	61C Ash (58)
41B2D Corn tassel (12)	61D Aspen (37)
41B2E Corn, normal stand (20)	61E Basswood (54)
41B2F Corn kernel (6)	61F Beech (24)
41B2G Corn, multicolored leaves (21)	61G Birch (23)
41B3 Oats (7)	61H Catalpa (12)
41B3A Oats field, stubble (9)	61I Elm (23)
41B4 Sorghum leaf, green (22)	61J Maple (45)
41B4A Sorghum, brown (15)	61J1 Silver maple (102)
41B5 Wheat (25)	61J2 Red maple (21)
41B5A Wheat field, normal stand (41)	61K Oak (45)
41B5B Wheat field, thin stand (35)	61K1 White Oak (47)
41B5C Wheat, diseased (13)	61K2 Black Oak (35)
41B5D Wheat heads (6)	61K3 Burr Oak (32)
41B5E Wheat, seedling stage (20)	61K4 Red Oak (374)
41C Clothing fibers (5)	61L Poplar (13)
41C1 Cotton (121)	61L1 Cottonwood (97)
42 Nonflowering plants and weeds (60)	61M Sweet gum (52)
42A Grass (50)	61N Sycamore (154)
42A1 Diseased grass (10)	61O Tulip tree (or Yellow Tulip poplar) (112)
42A2 Brown grass (59)	61P Willows (8)
42B Nylas (13)	62 Coniferous (37)
43 Flowering plants (36)	62A Pine (19)
43A Alfalfa (32)	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 SiO₂ 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	103N Dunite (8)
101 Acidic (Generally greater than 65% SiO ₂) Silicate Rocks (1)	103P Lava (5)
101B Obsidian (5)	103Q Anorthosite (1)
101C Pumice (8)	110 Sedimentary and Metamorphic Rocks (2)
101D Tuff (9)	111 Silicate Sedimentary and Metamorphic Rocks (2)
101E Tektite (same as 142) (1)	111A Sandstone (1)
101F Quartz Monzonite (6)	111A1 Yellow Sandstone (2)
101G Dacite (15)	111A2 Red Sandstone (2)
101H Granite (6)	111A3 Grey Sandstone (1)
101H1 Graphic Granite (1)	111B Schist (1)
101H2 Granite Gneiss (2)	111F Shale (2)
101H3 Potash Granite (1)	111H Siltstone (4)
101J Aplite (1)	111J Chert (3)
101J1 Granite Aplite (1)	111K Quartzite (2)
101J2 Pyroxene Aplite (1)	112 Carbonate Sedimentary and Metamorphic Rocks (2)
101L Rhyolite (26)	112A Limestone (13)
101N Trachyte (2)	112B Coral (2)
101Q Migmatite (2)	112C Dolomite (same as 123A1) (1)
101R Adamellite (8)	112D Marble (1)
101T Felsite (3)	120 Minerals
101U Pegmatite (4)	121 Silicate Minerals (Associated primarily with Acidic Rocks)
101V Monzonite (5)	121A Quartz (44)
102 Intermediate (Generally 53% to 65% SiO ₂) Silicate Rocks	121B K-Feldspar (Orthoclase) (9)
102A Syenite (4)	121C Grey Feldspar (Plagioclase) (21)
102A1 Quartz Syenite (1)	121D Light-Colored Micas (3)
102A2 Nepheline Syenite (2)	121E Clay minerals (Product of Weathering) (14)
102B Andesite (22)	122 Ferromagnesian Minerals (Associated primarily with Basic Rocks)
102B1 Hypersthene Andesite (2)	122A Biotite and Phlogopite (3)
102B2 Hypersthene Andesite Vitrophyre	122B Olivines (13)
102B3 Biotite Andesite Flow (2)	122C Pyroxenes (19)
102D Basalt (Intermediate) (1)	122D Amphiboles (28)
102G Diorite (13)	122E Chlorites (Product of Weathering) (7)
102G1 Augitediorite (1)	122F Serpentine (Alteration Product) (4)
102I Latite (30)	122G Talc (Alteration Product) (4)
102P Grandiorite (4)	123 Accessory Minerals (7)
103 Basic and Ultrabasic (Generally less than 53% SiO ₂) Silicate Rocks (2)	123A Carbonate Minerals (4)
103A Gabbro (6)	123A1 Calcium-Magnesium Carbonate (Dolomite) (Same as 112C) (9)
103A1 Garnet Gabbro (1)	123A2 Magnesium Carbonate (Magnesite) (8)
103A2 Augite Gabbro (1)	123A3 Calcium Carbonate (Calcite Limestone) (10)
103A3 Olivine Gabbro (1)	123A4 Sodium Carbonate (2)
103A4 Hornblende Gabbro (2)	123A5 Copper Carbonate (Azurite, Malachite) (8)
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)	

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

123A6 Manganese Carbonate (Rhodochrosite) (3)	123B17 Silver Sulfates and Sulfides (Proustite, Pyrargyrite) (6)
123A7 Iron Carbonate (Siderite) (4)	123B18 Zinc Sulfates and Sulfides (Sphalerite) (2)
123A8 Zinc Carbonate (Smithsonite) (2)	123C Nitrate and Nitrite Minerals
123A9 Strontium Carbonate (Strontianite) (2)	123C1 Sodium Nitrates and Nitrites (2)
123A10 Barium Carbonate (Witherite) (3)	123C2 Potassium Nitrates and Nitrites (2)
123B Sulphur, Sulfate and Sulfide Minerals (1)	123D Phosphate Minerals
123B1 Sulphur (4)	123E Carbonaceous Minerals
123B2 Calcium Sulfates and Sulfides (Gypsum, Anhydrite Sand) (25)	123E1 Silicon Carbide (4)
123B3 Aluminum Sulfates and Sulfides (Alunite) (4)	123E2 Graphite (1)
123B4 Barium Sulfates and Sulfides (Barite) (4)	123E3 Peat and Coal (1)
123B5 Strontium Sulfates and Sulfides (Celestite) (4)	123F Oxides and Hydroxides
123B6 Sodium Sulfates and Sulfides (Thenardite) (4)	123F1 Iron Ox. and Hydrox. (Limonite, Hematite, Goethite, Magnetite, Ilmenite) (25)
123B7 Iron Sulfates and Sulfides (Pyrite, Pyrrhotite, Jarosite, Arsenopyrite, Chalcopyrite, Jamesonite, Marcasite) (26)	123F2 Manganese Ox. and Hydrox. (Psilomelane, Pyrolusite) (10)
123B8 Arsenic Sulfates and Sulfides (Realgar, Arsenopyrite, Enargite, Niccolite, Proustite, Cobaltite) (21)	123F3 Titanium Ox. and Hydrox. (Rutile, Ilmenite) (9)
123B9 Potassium Sulfates and Sulfides (Alunite, Jarosite) (5)	123F4 Zinc Ox. and Hydrox. (Zincite) (4)
123B10 Copper Sulfates and Sulfides (Chalcocite, Chalcopyrite, Enargite) (13)	123F5 Aluminum Ox. and Hydrox. (Corundum and Artificial Ruby, Diaspore, Gibbsite, Chrysoberyl) (18)
123B11 Mercury Sulfates and Sulfides (Cinnabar) (3)	123F6 Beryllium Ox. and Hydrox. (Chrysoberyl) (4)
123B12 Cobalt Sulfates and Sulfides (Cobaltite) (4)	123F7 Copper Ox. and Hydrox. (Cuprite) (3)
123B13 Lead Sulfates and Sulfides (Galena, Jamesonite) (7)	123F8 Tin Ox. and Hydrox. (Cassiterite) (4)
123B14 Antimony Sulfates and Sulfides (Stibnite, Jamesonite, Pyrargyrite) (11)	123F9 Magnesium Ox. and Hydrox. (Brucite) (4)
123B15 Molybdenum Sulfates and Sulfides (Molybdenite) (3)	123G Halides
123B16 Nickel Sulfates and Sulfides (Niccolite) (3)	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} .

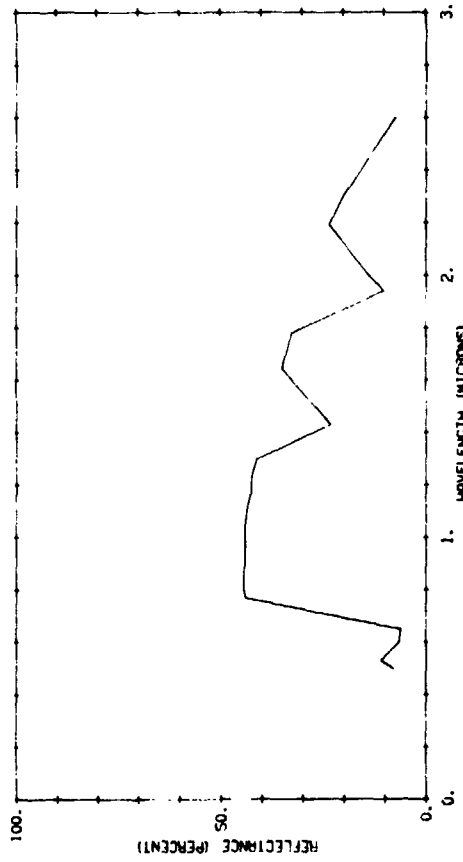
* Definition from W. A. Shurcliff, *Polarized Light*, Harvard University Press, Cambridge, Mass., 1965.

**61K4
RED OAK**

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

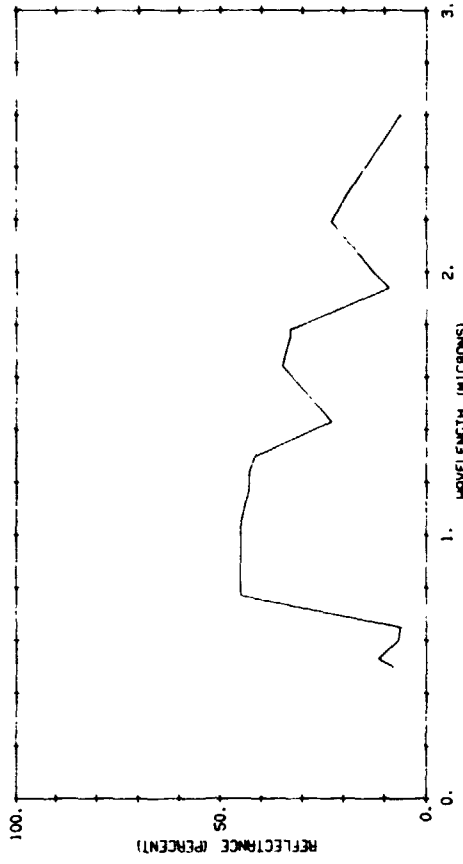
B09007 001

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



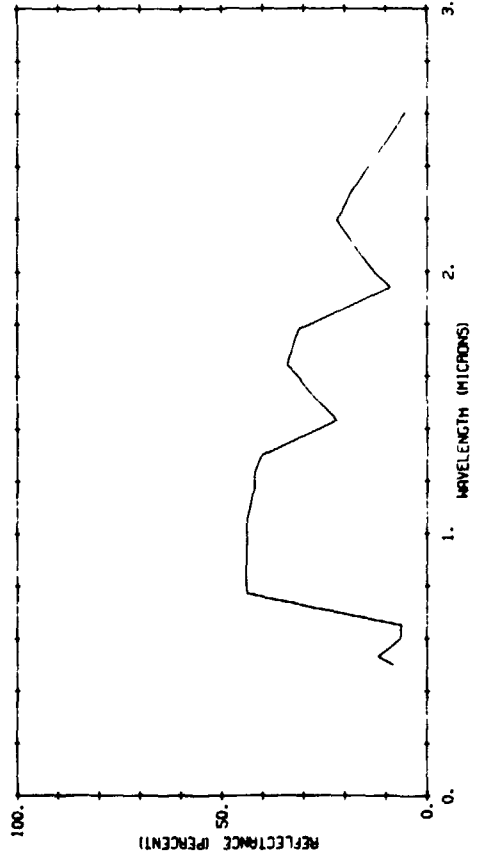
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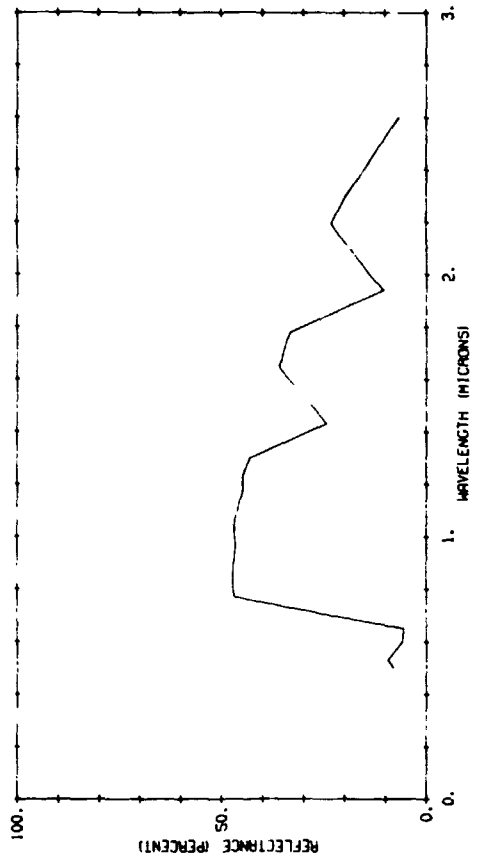
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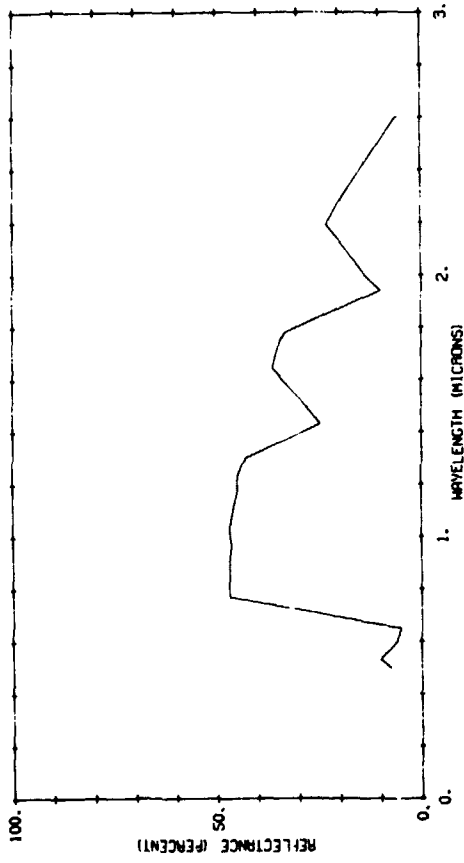
B09007 004

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



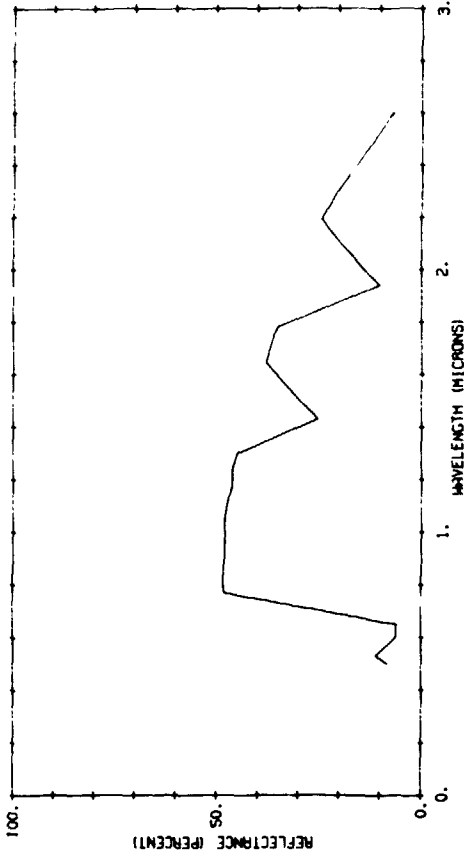
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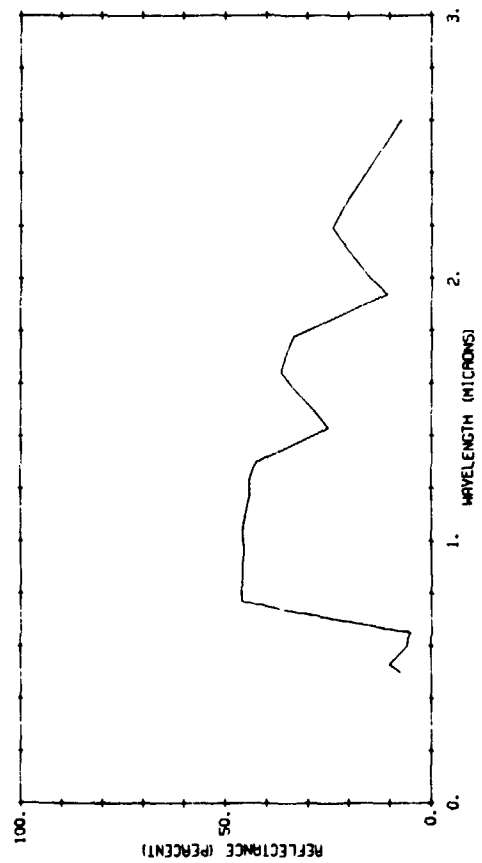
B09007 006

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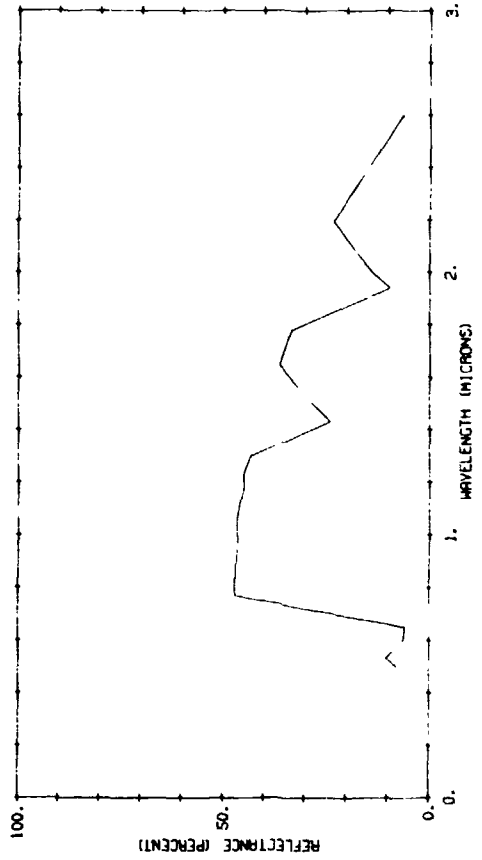
B09007 007

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



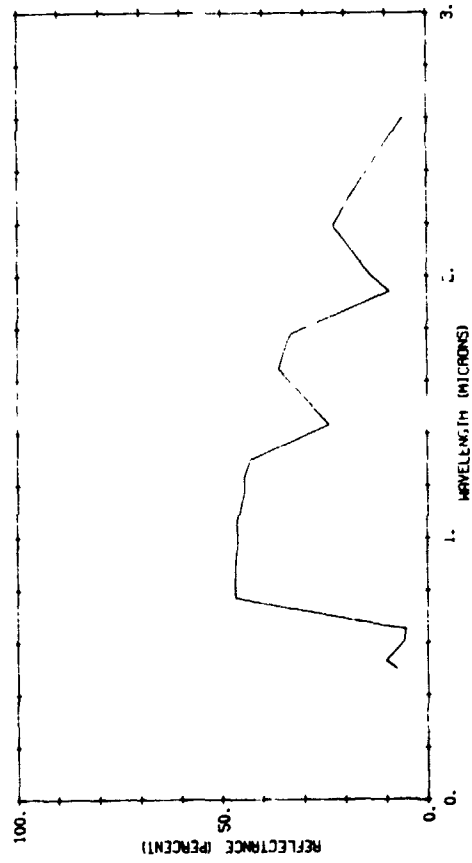
B09007 009

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



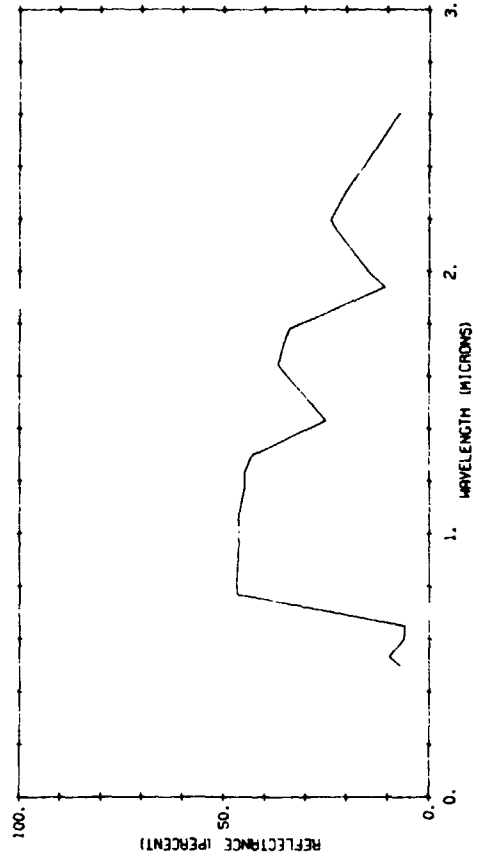
B09007 009

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



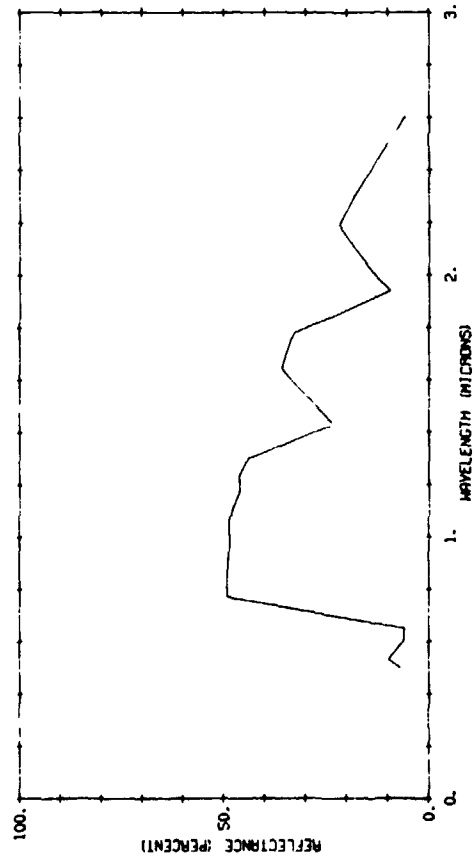
B09007 010

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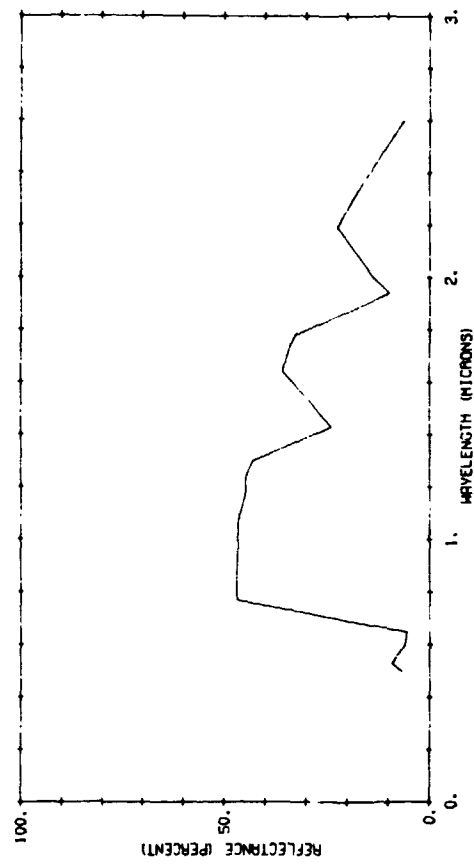
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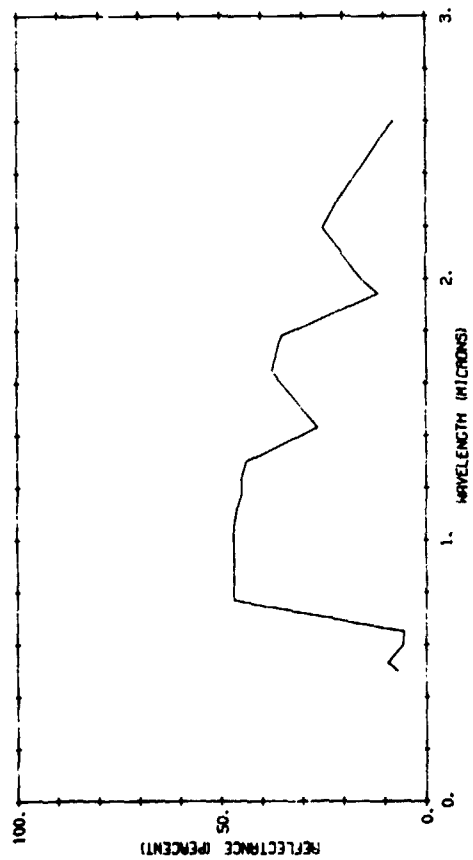
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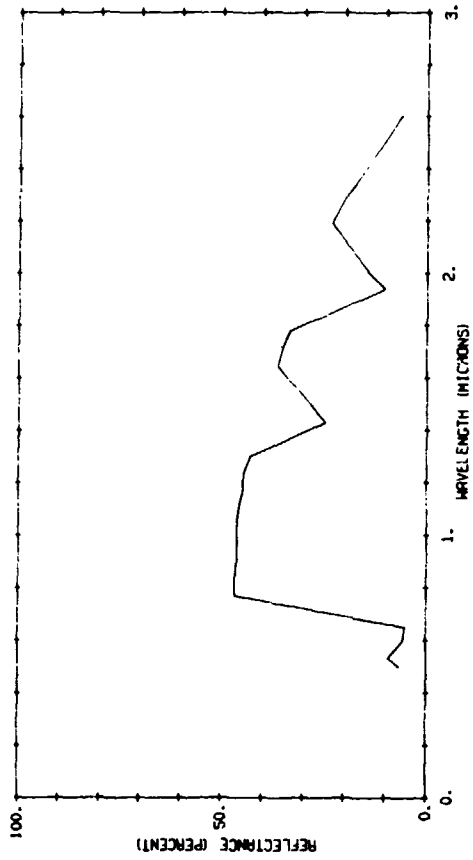
B09007 013

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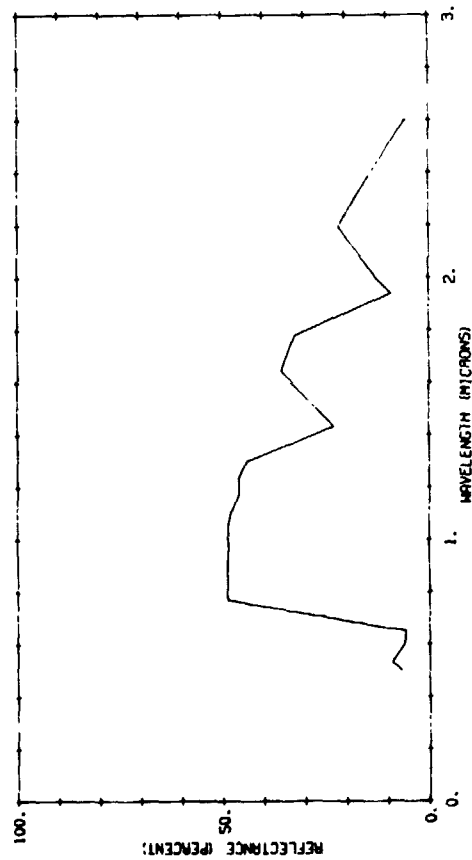
B09007 014

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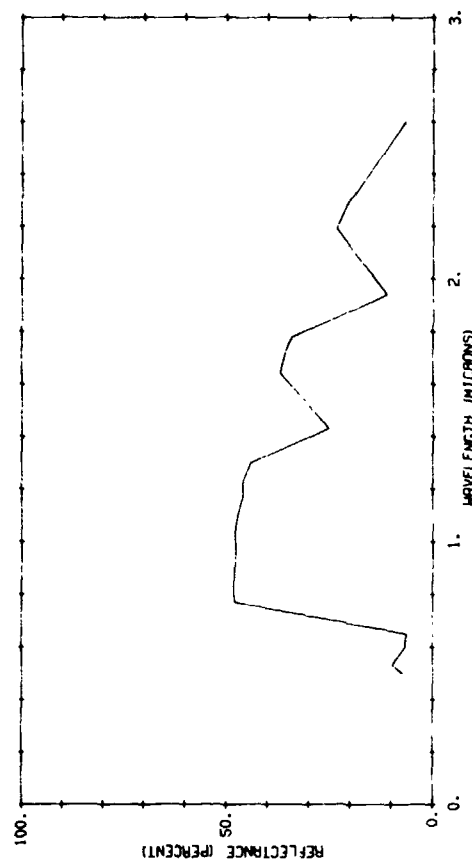
B09007 015

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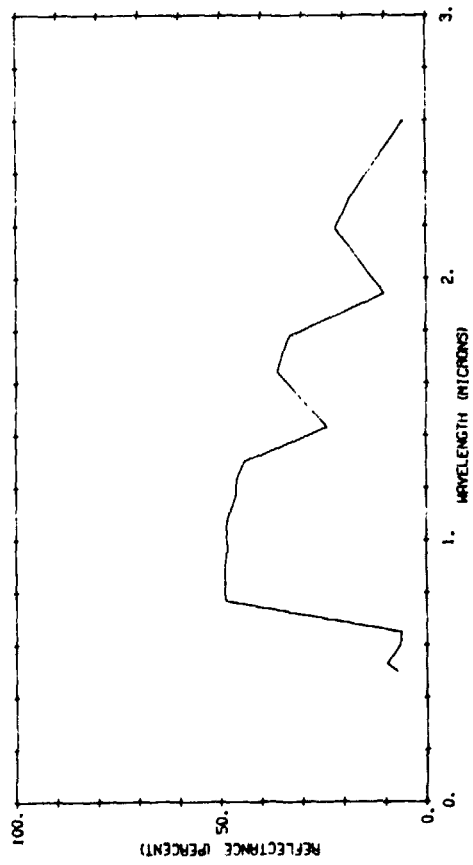
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TREE 1, LEAF 1. WATERED EVERY SECOND OR THIRD DAY



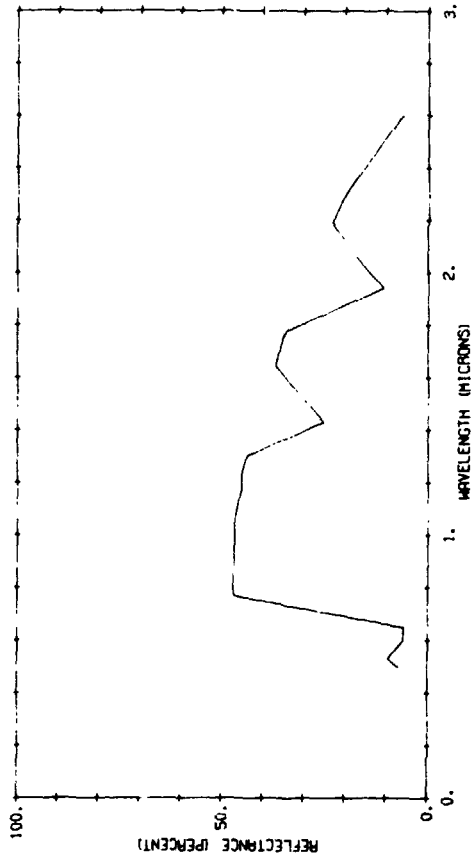
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TREE 1, LEAF 2. WATERED EVERY SECOND OR THIRD DAY



B09007 018

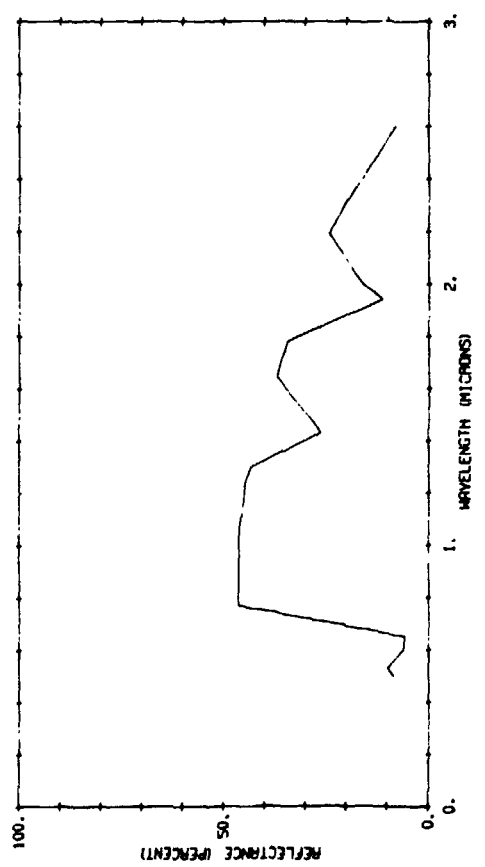
TREE 1, LEAF 3. WATERED EVERY SECOND OR THIRD DAY



61 K4 - 5

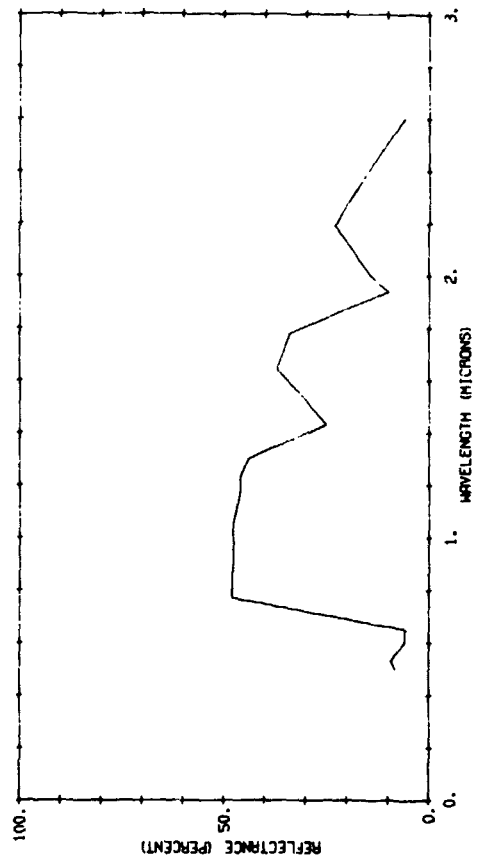
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TREE 1, LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



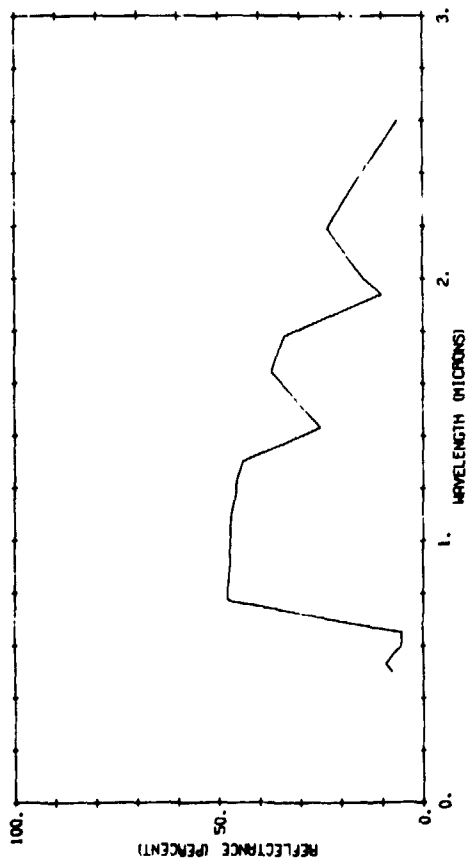
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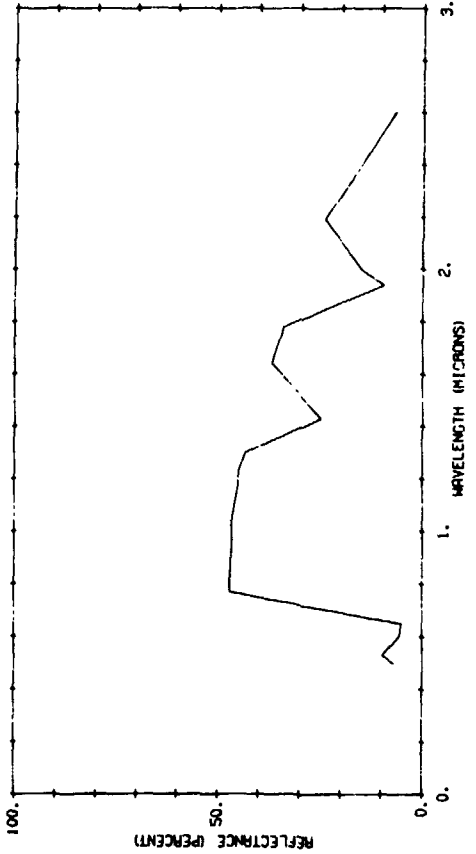
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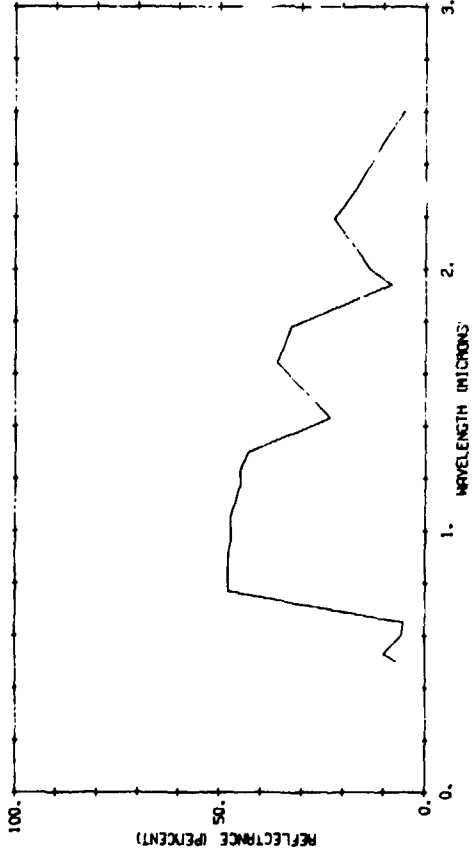
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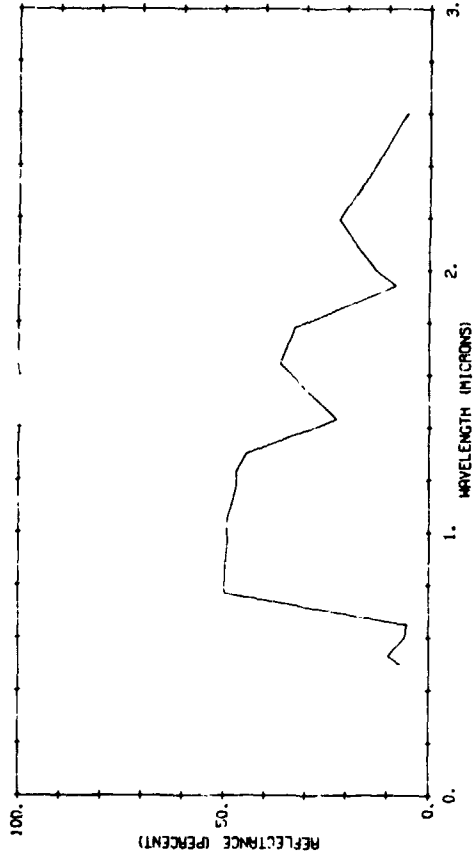
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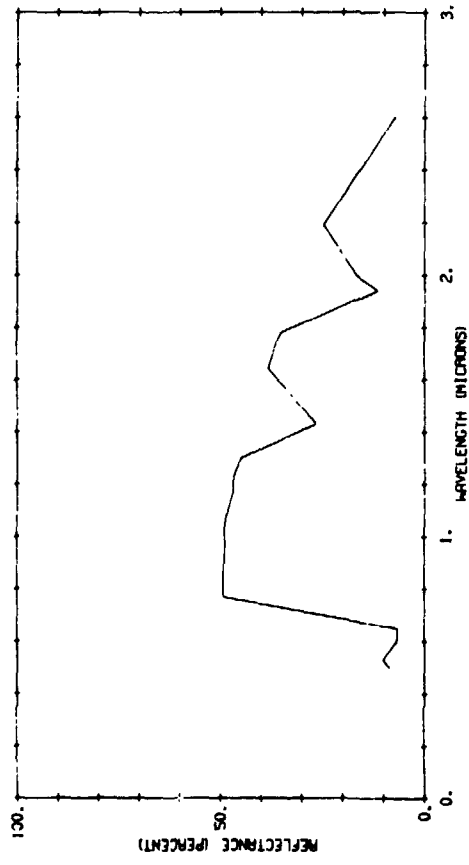
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TREE 1, LEAF 3. WATERED EVERY SECOND OR THIR



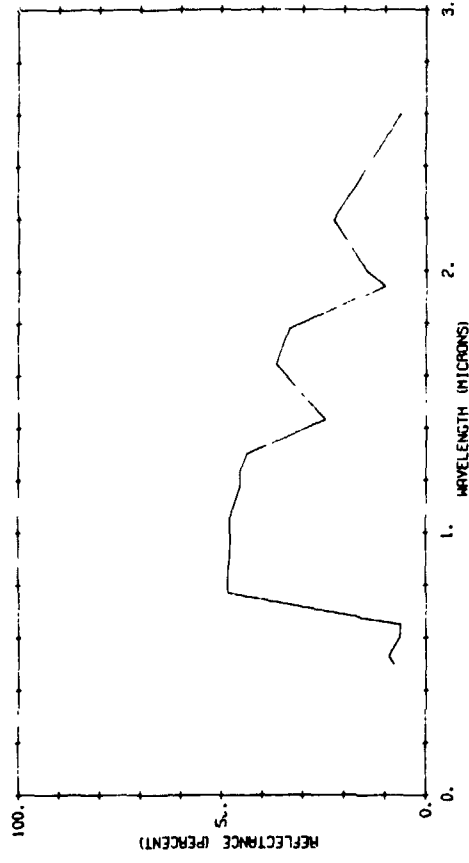
809007 025

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



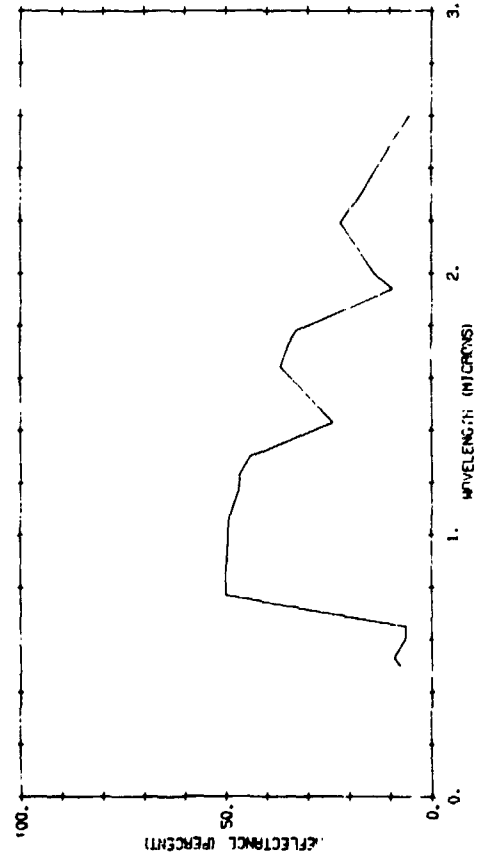
809007 026

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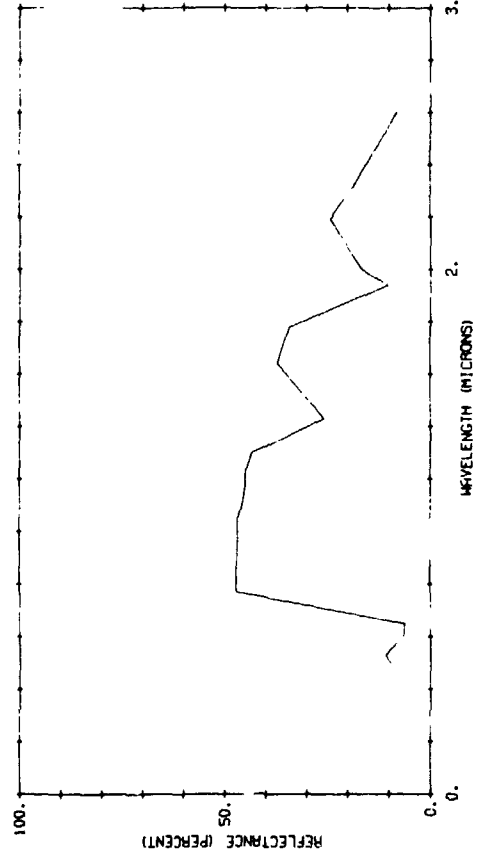
809007 027

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



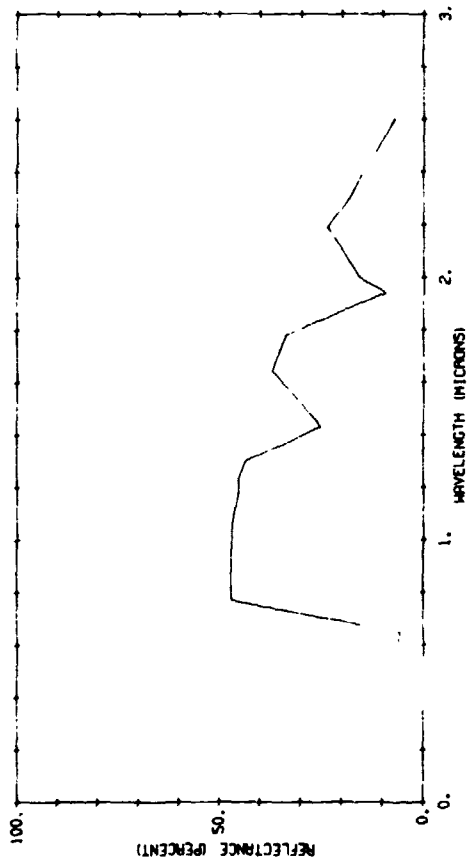
809007 028

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



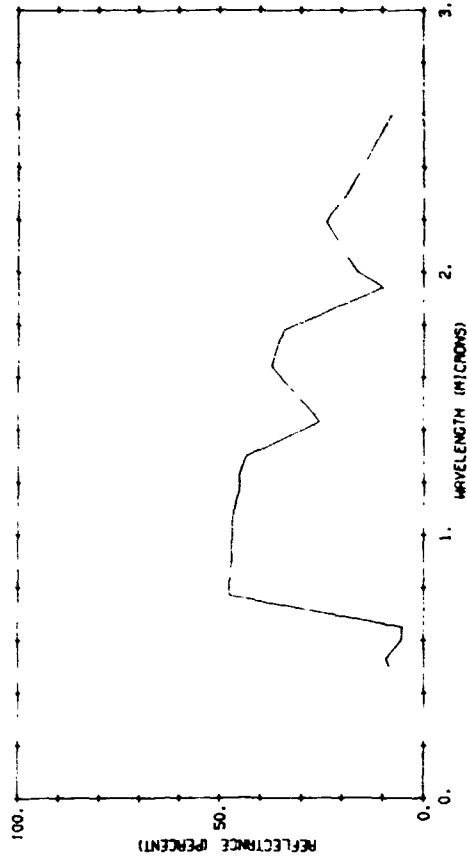
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TREE 1, LEAF 2 WATERED EVERY SECOND OR THIRD DAY



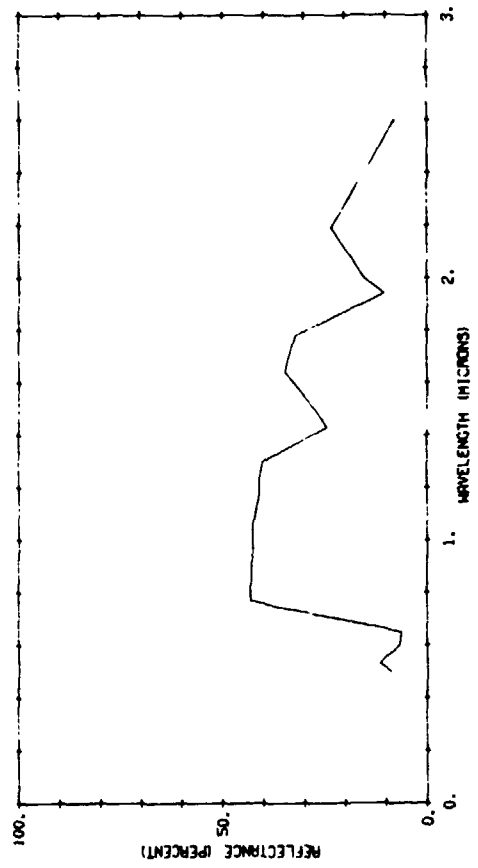
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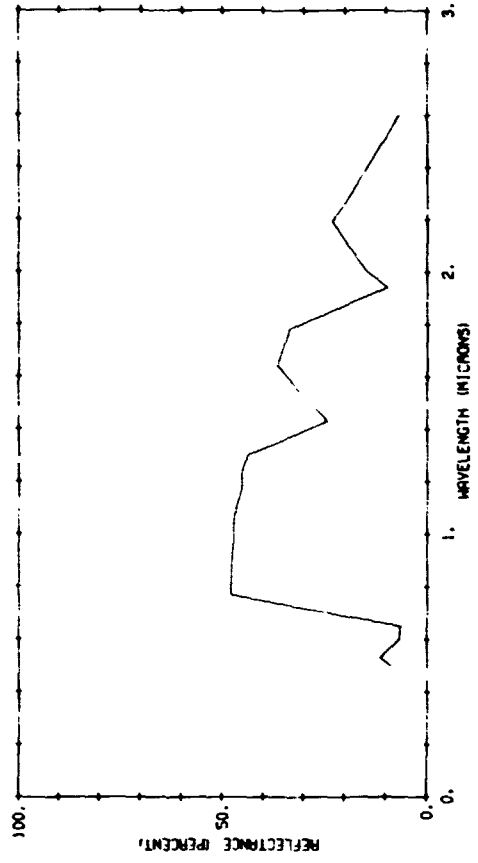
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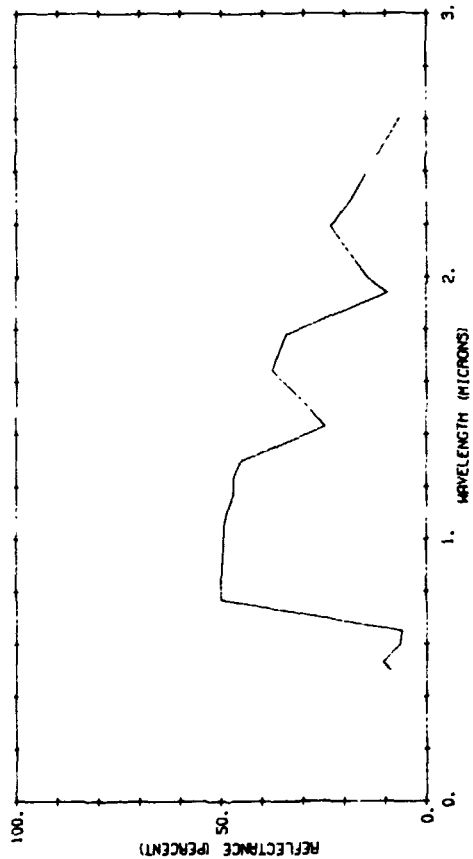
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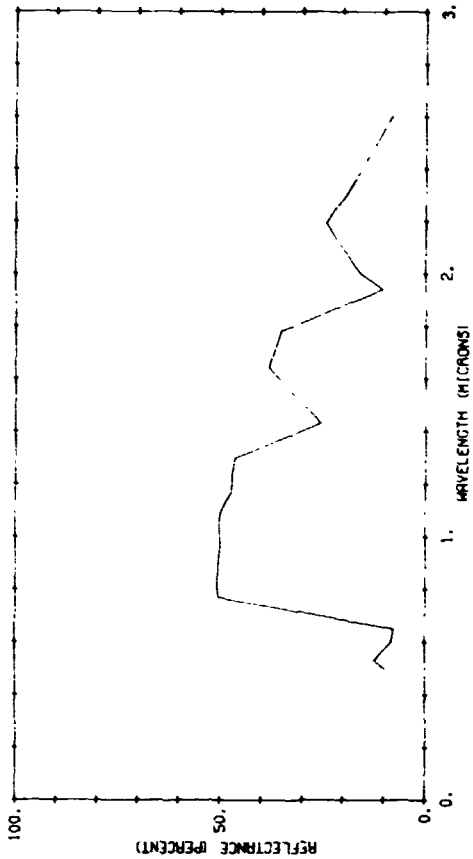
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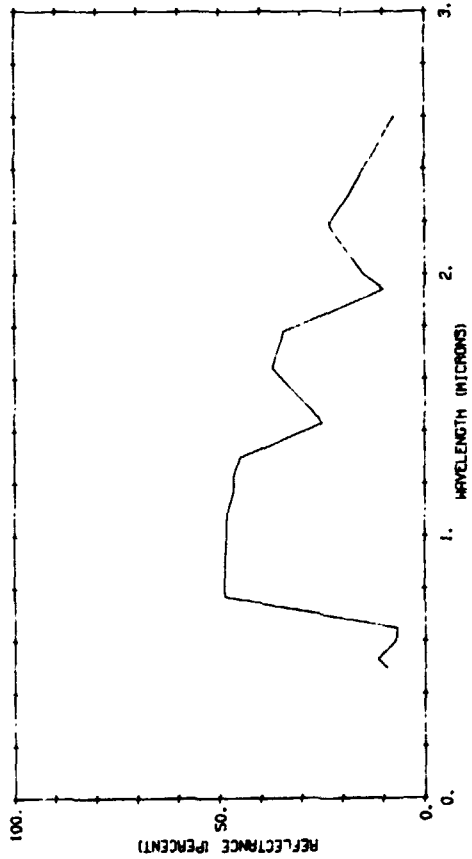
809007 034

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



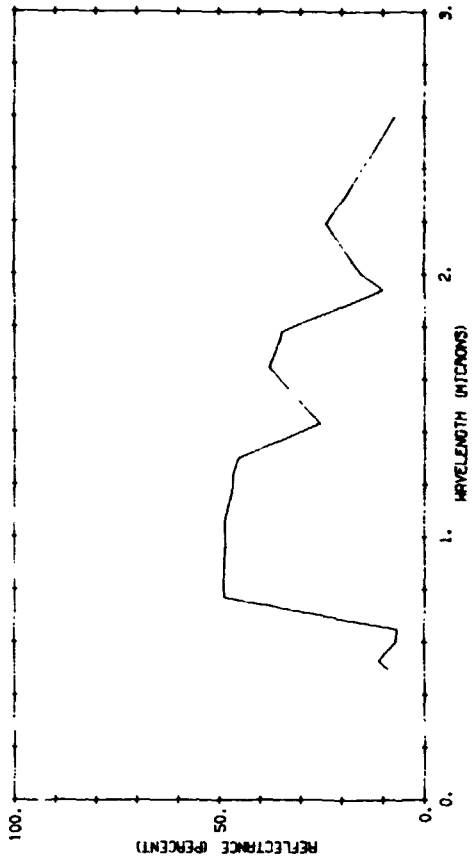
809007 035

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



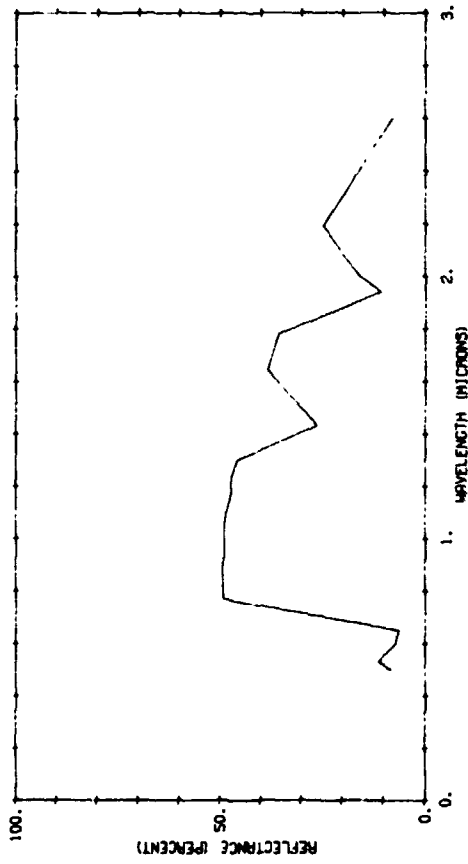
809007 036

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



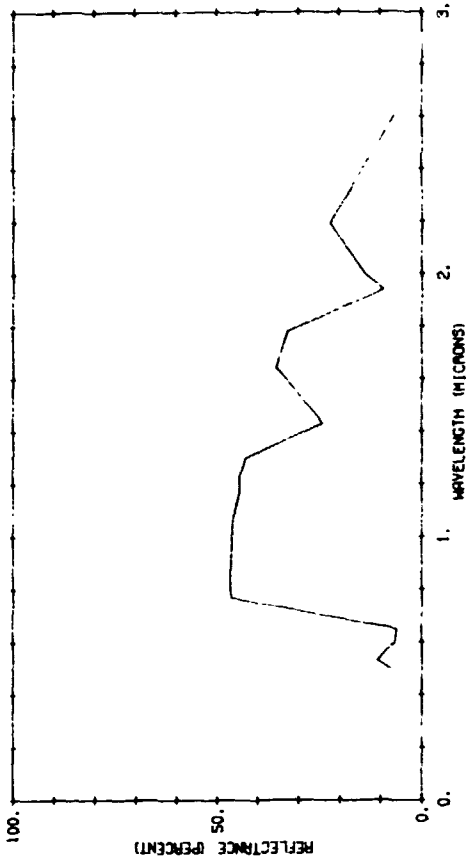
809007 037

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



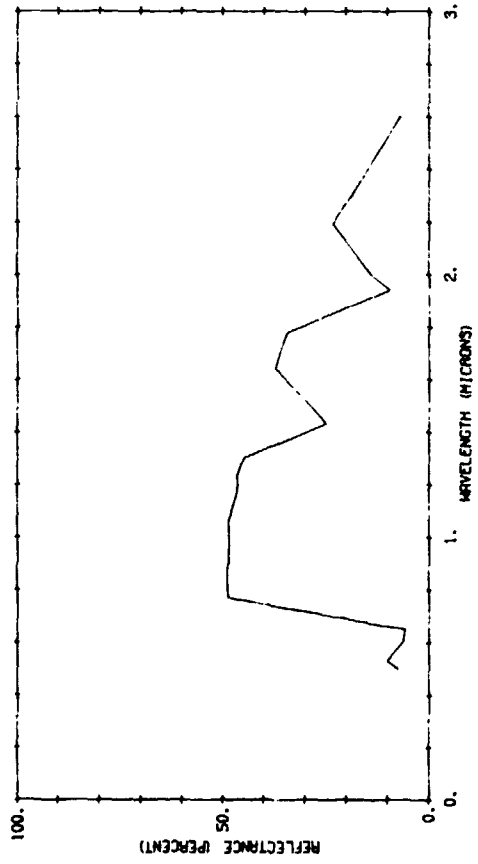
309007 038

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



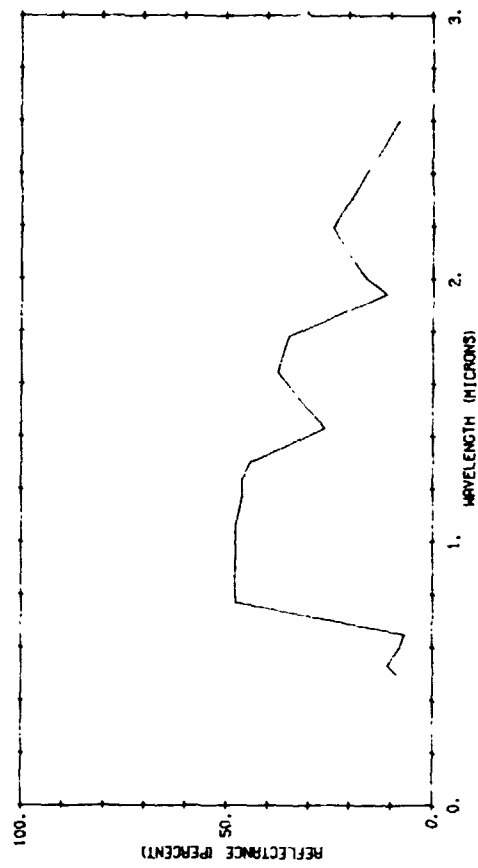
809007 039

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



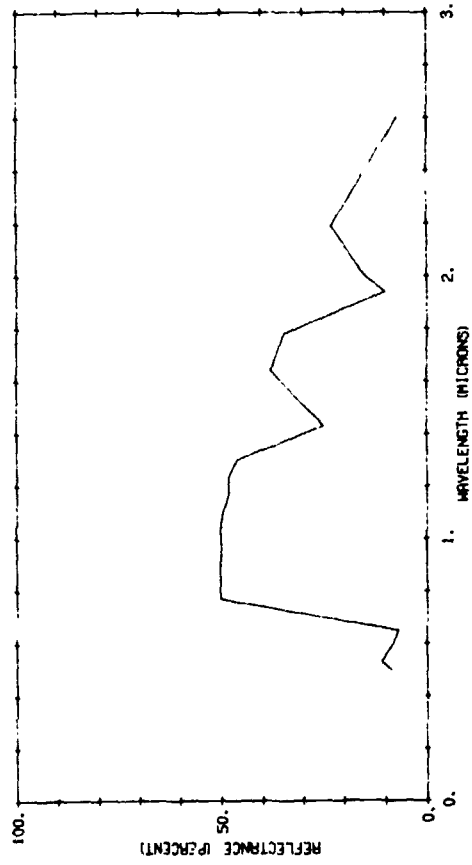
809007 040

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



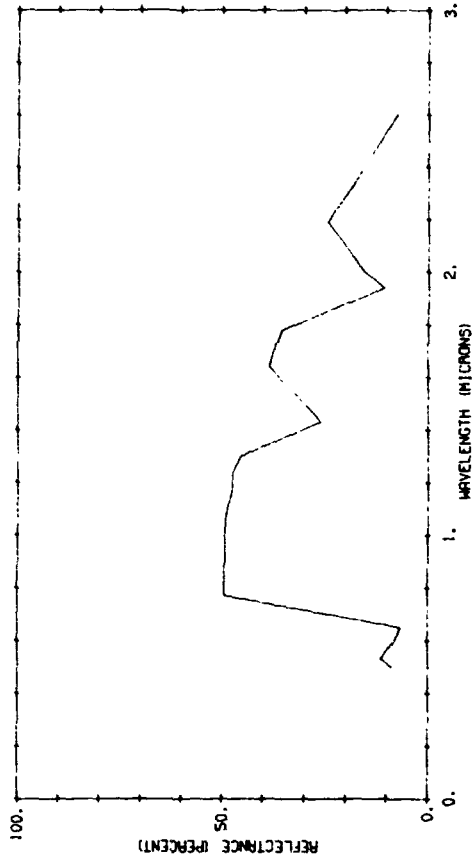
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TREE 1. LEAF 2. WATERED EVERY SECOND OR THIRD DAY.



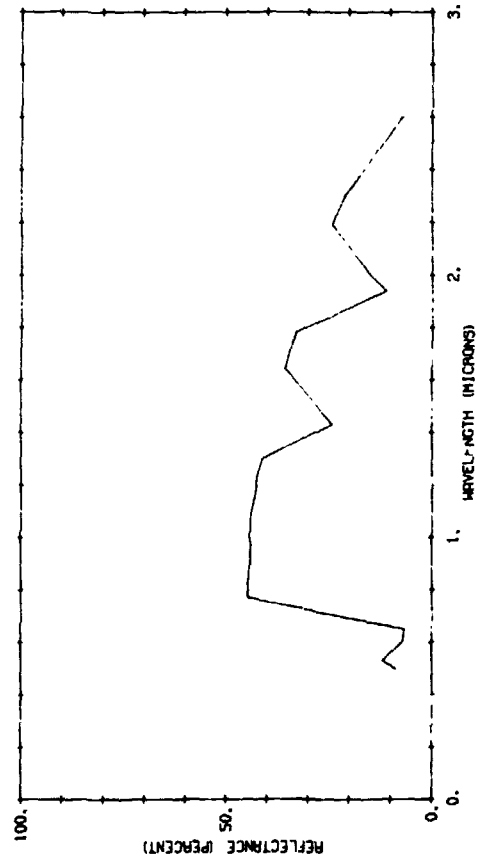
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TREE 1. LEAF 3. WATERED EVERY SECOND OR THIRD DAY



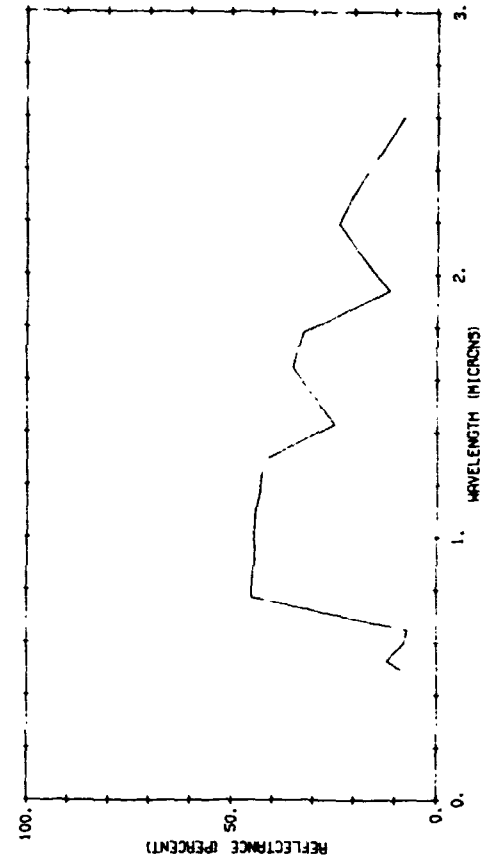
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TREE 2. LEAF 1. WATERED EVERY SECOND OR THIRD DAY.



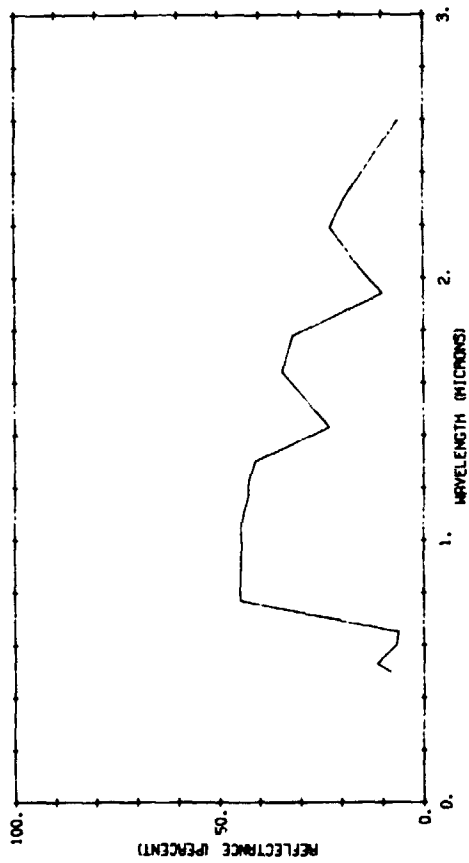
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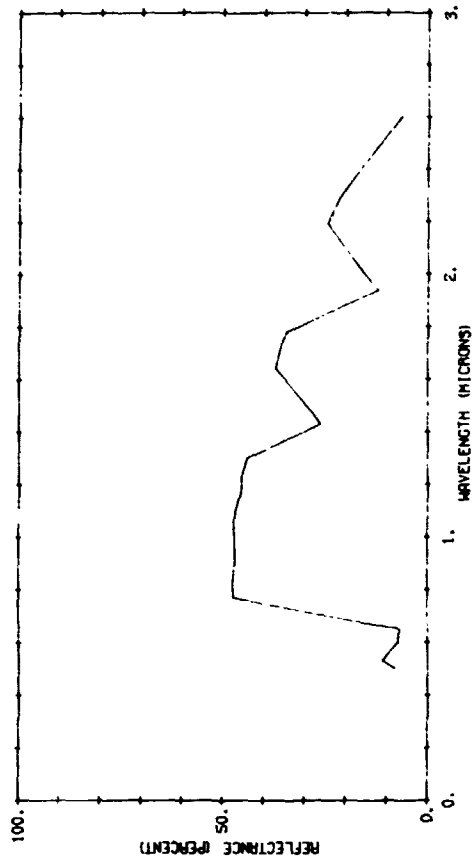
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TREE 2, LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



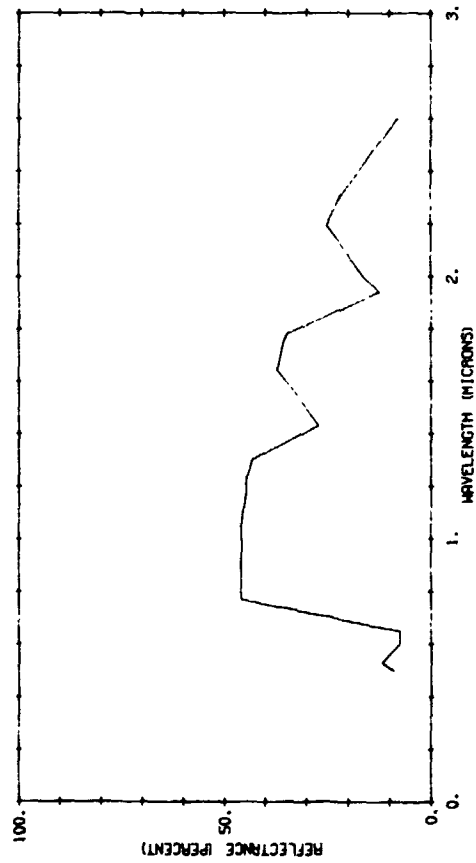
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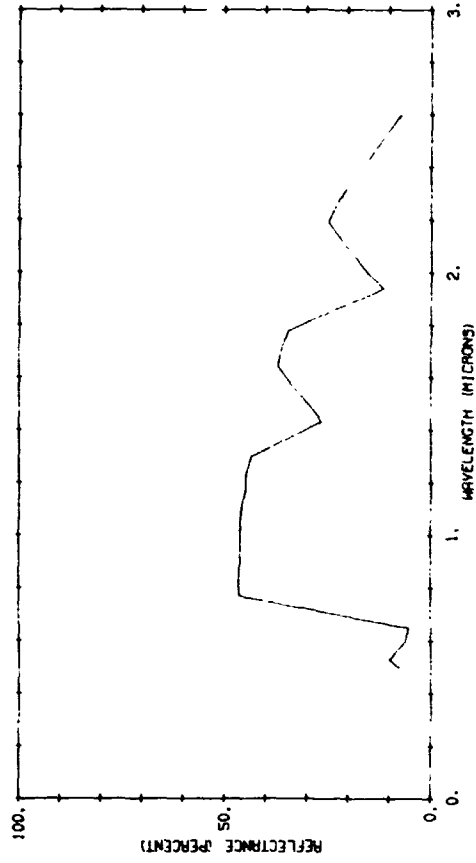
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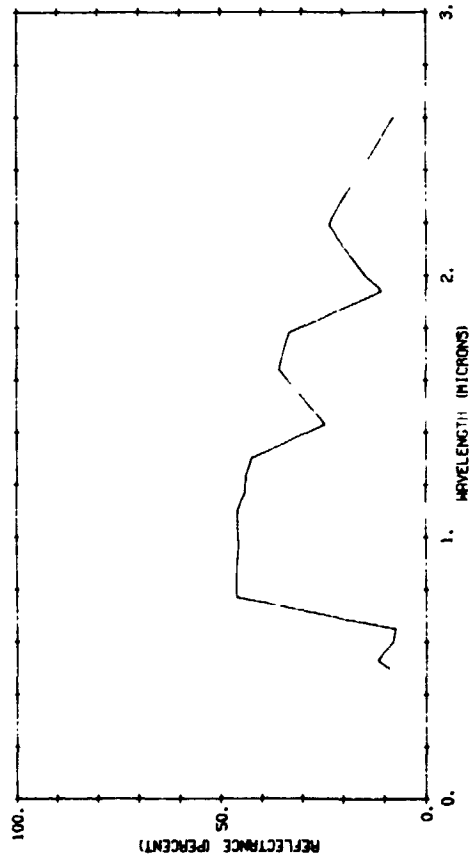
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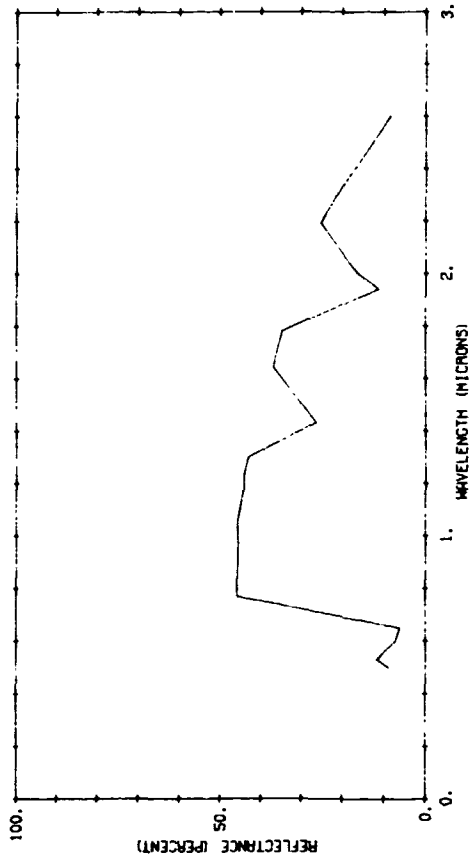
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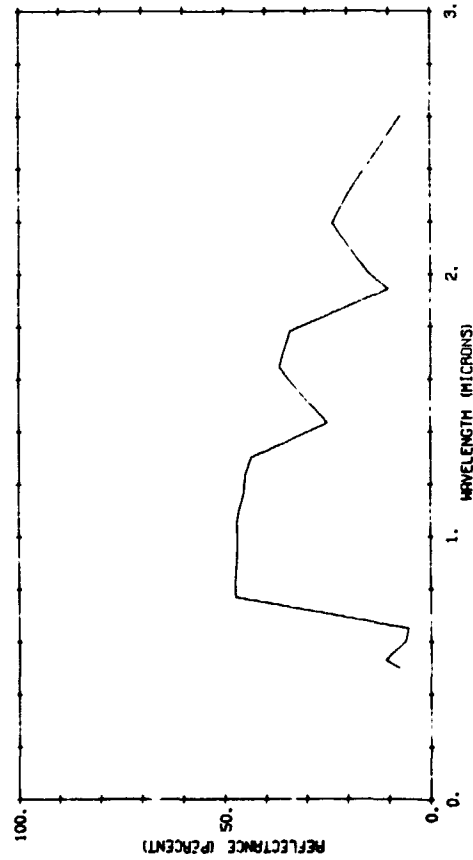
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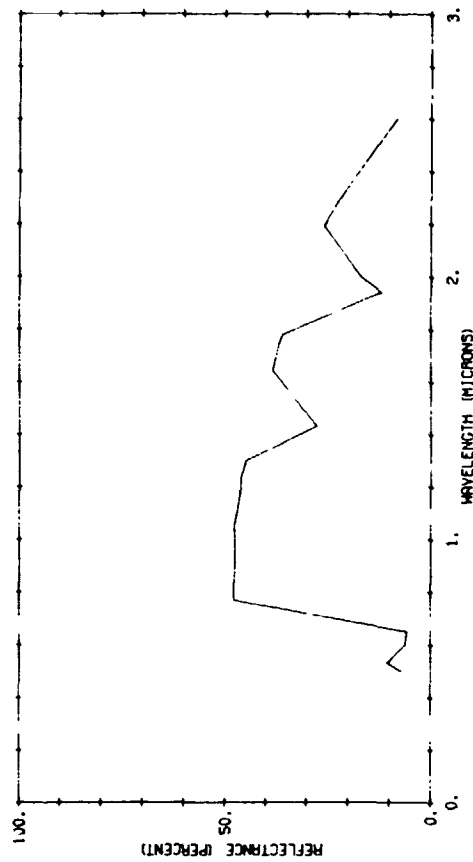
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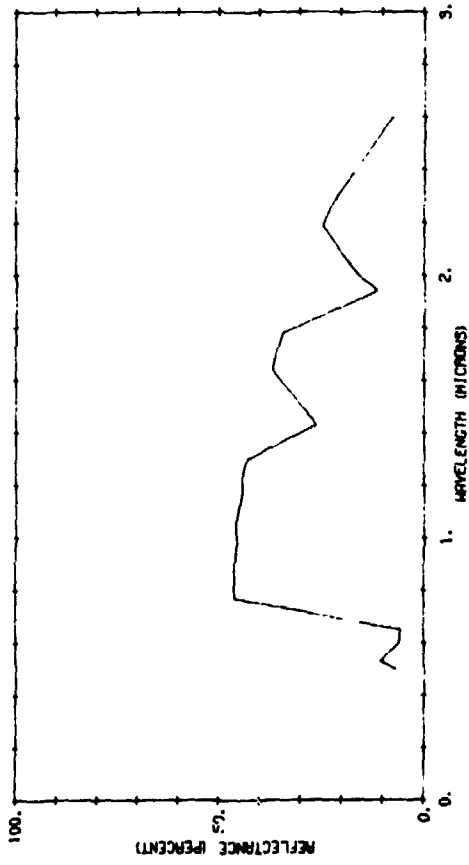
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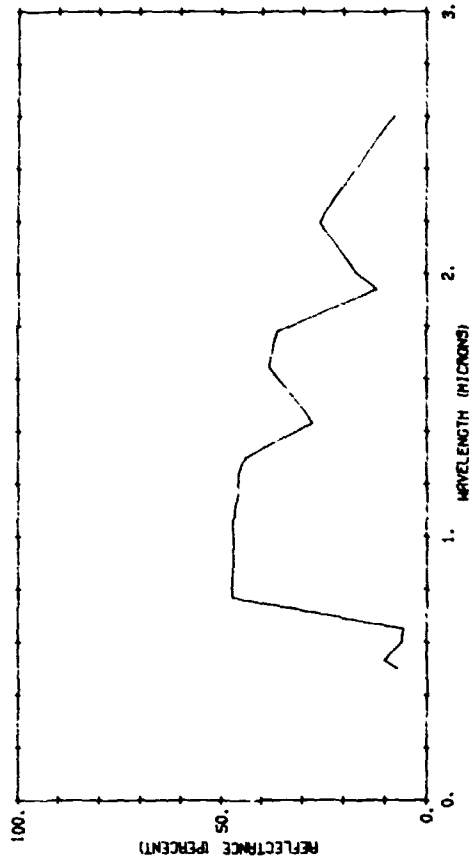
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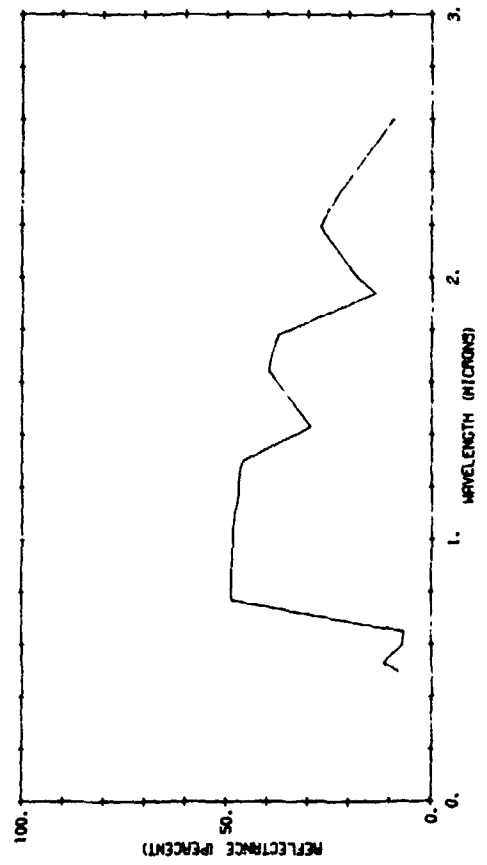
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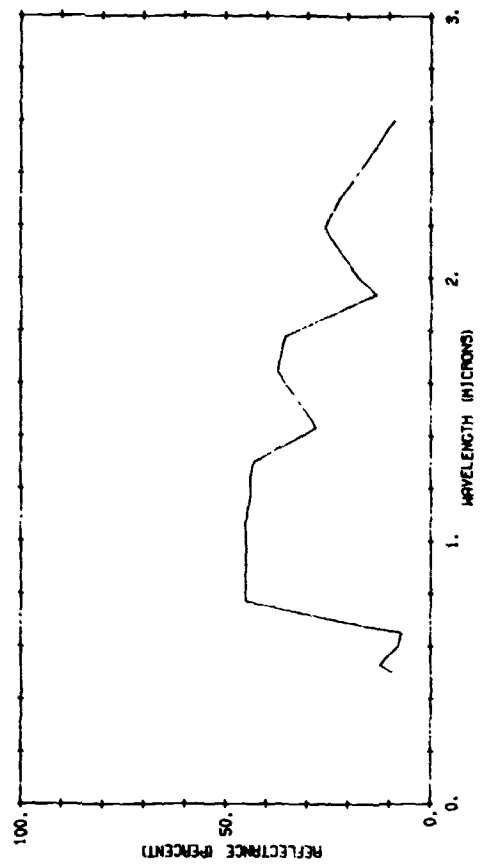
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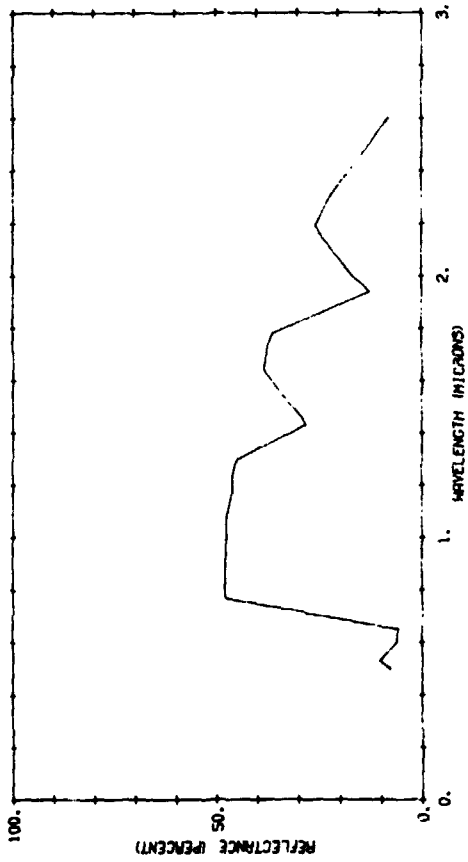
809007 056

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



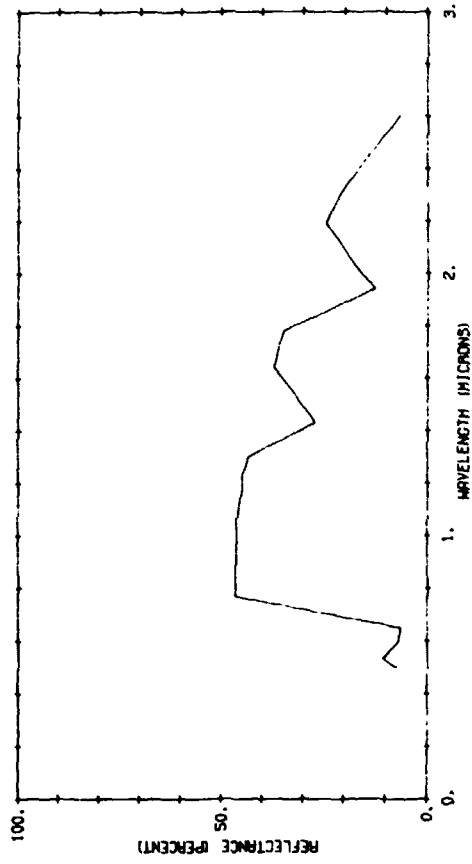
809007 057

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



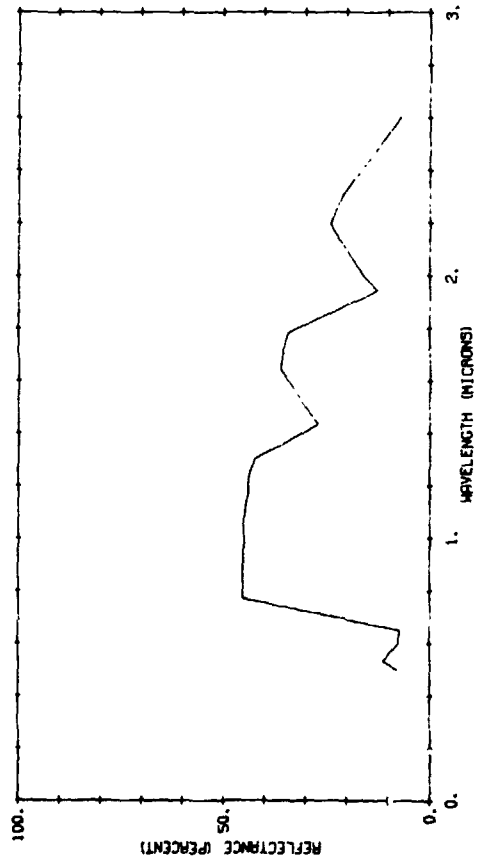
809007 058

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



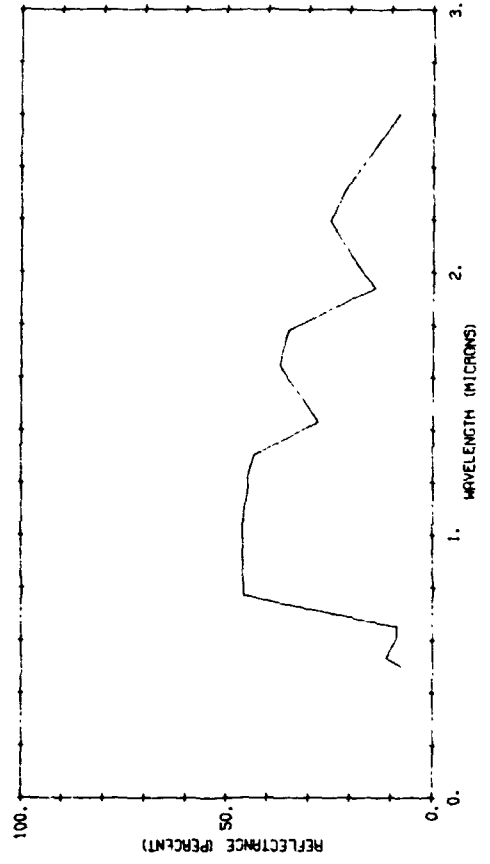
809007 059

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



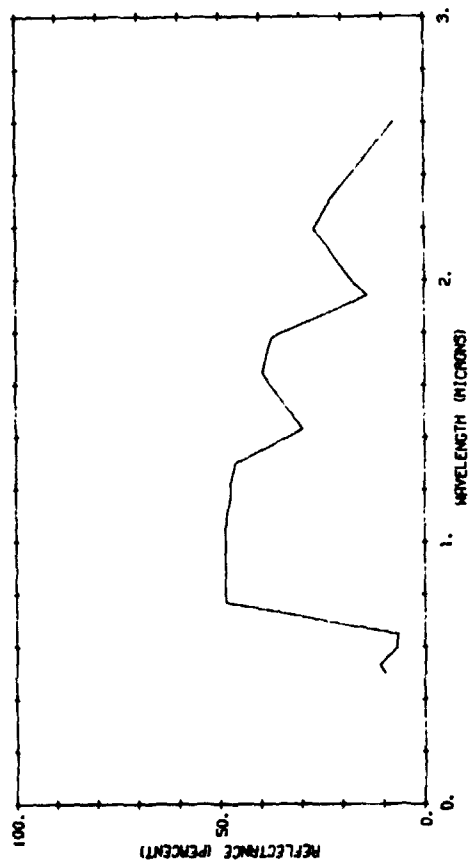
809007 060

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



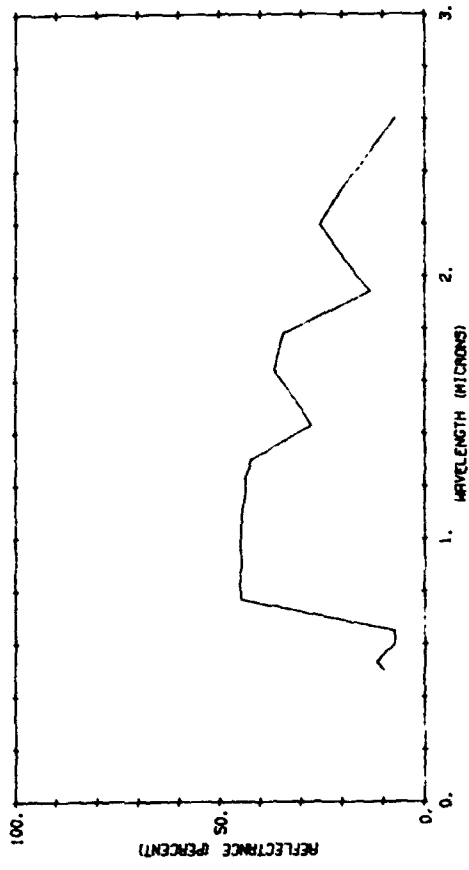
B09007 061

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



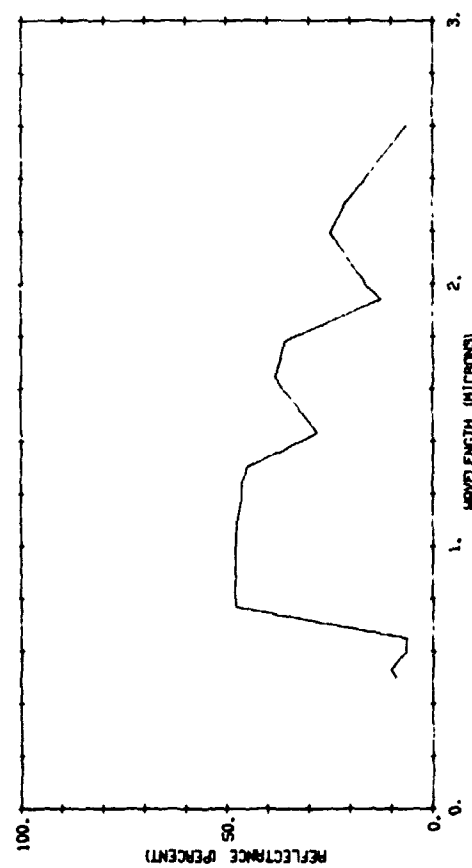
B09007 062

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



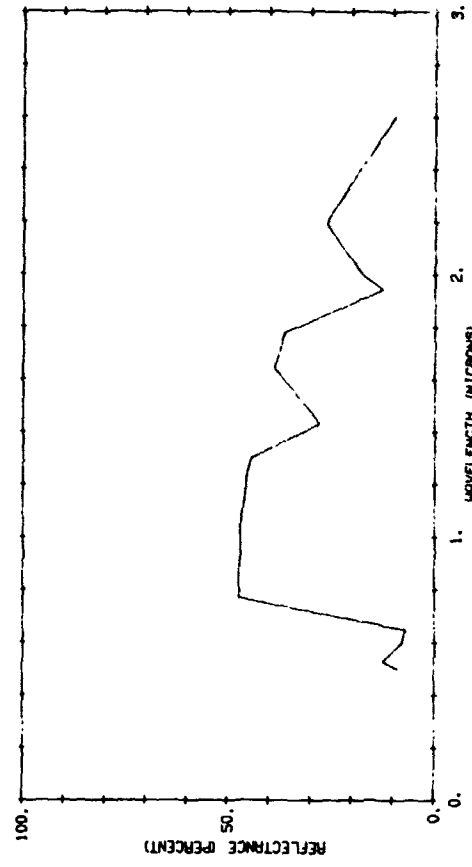
B09007 063

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



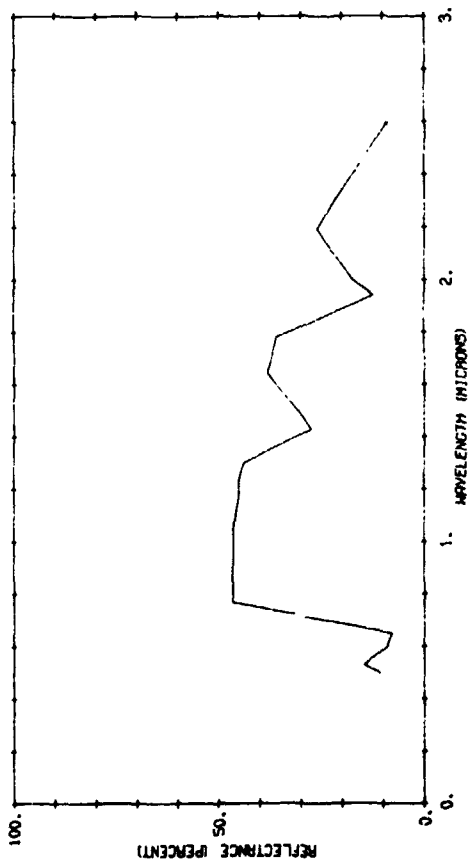
B09007 064

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



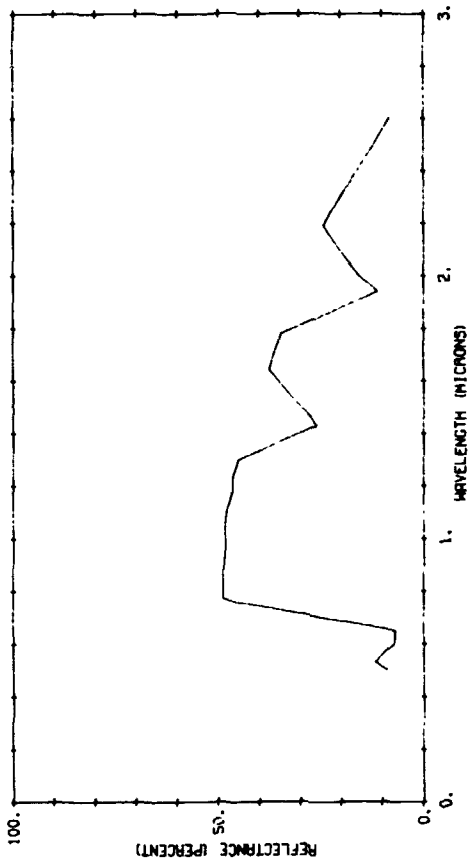
809007 065

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



809007 066

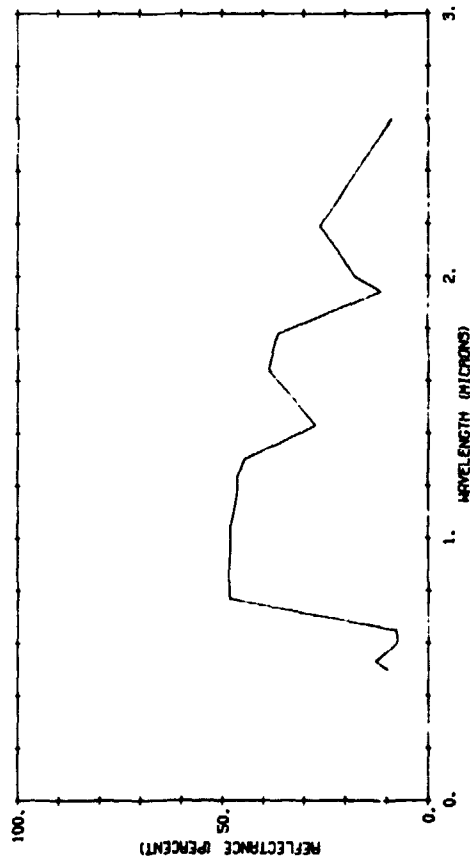
TREE 2. LEAF 3. WATERED EVERY SECOND OR THIRD DAY.



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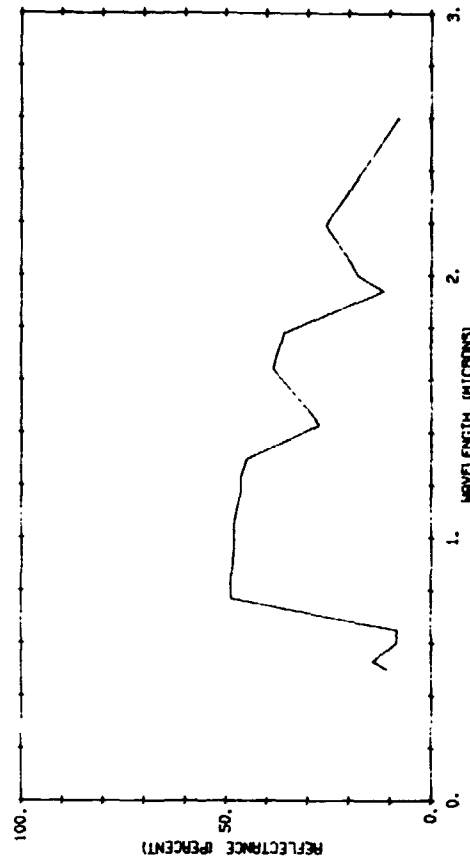
809007 067

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



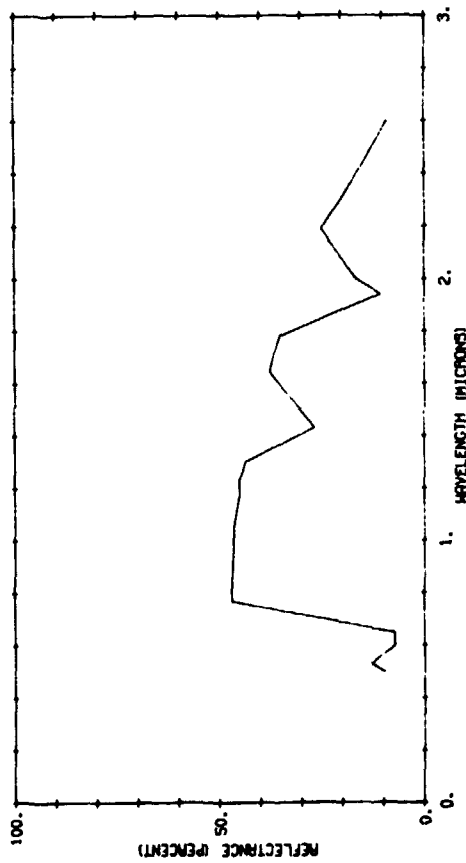
809007 068

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



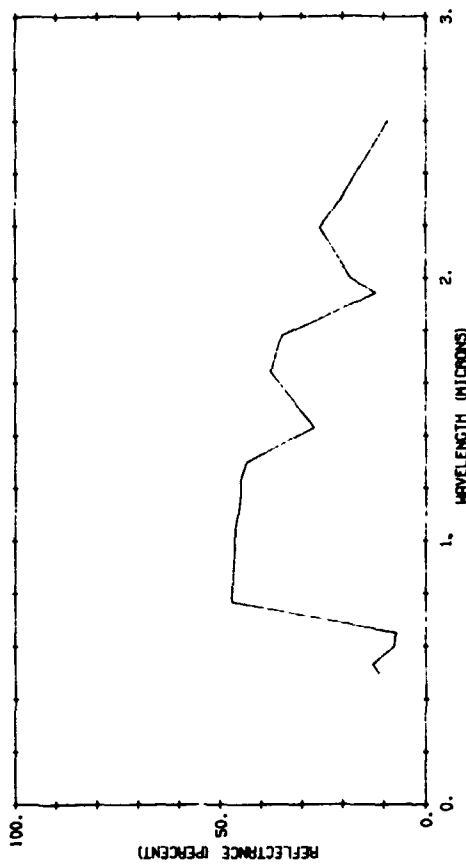
B09007 069

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



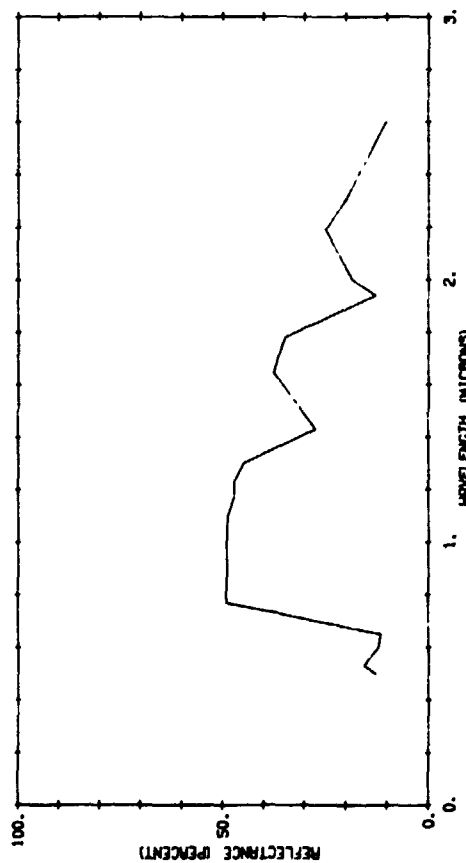
B09007 070

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



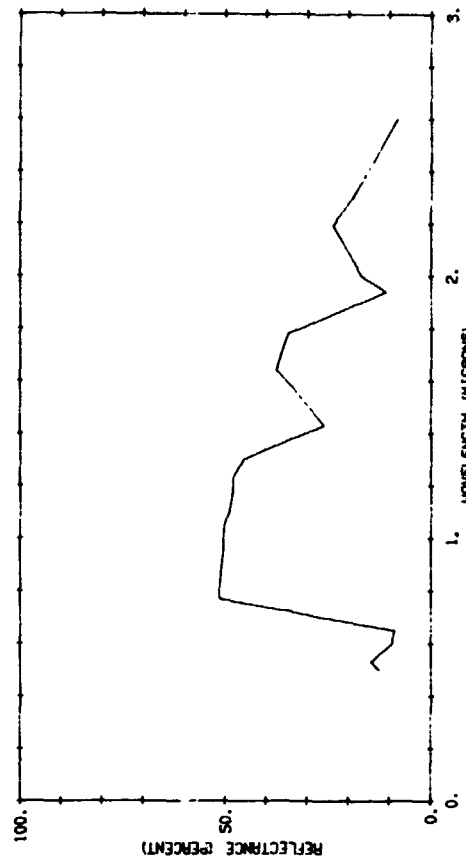
B09007 071

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



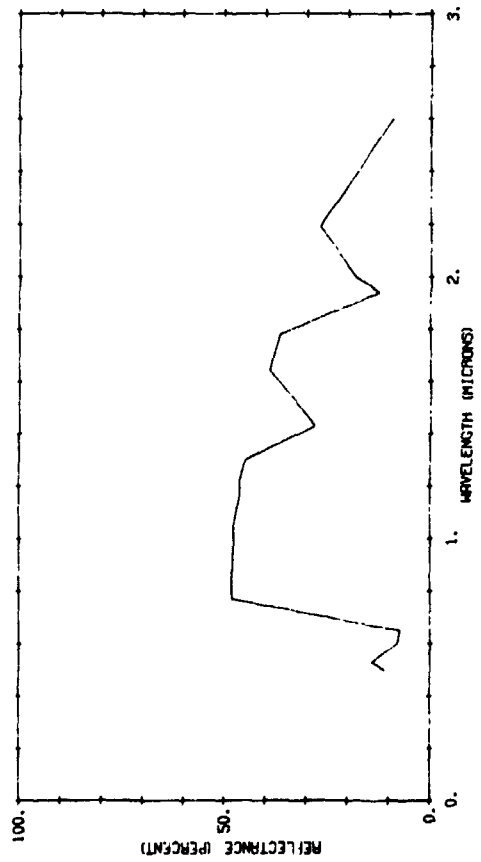
B09007 072

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



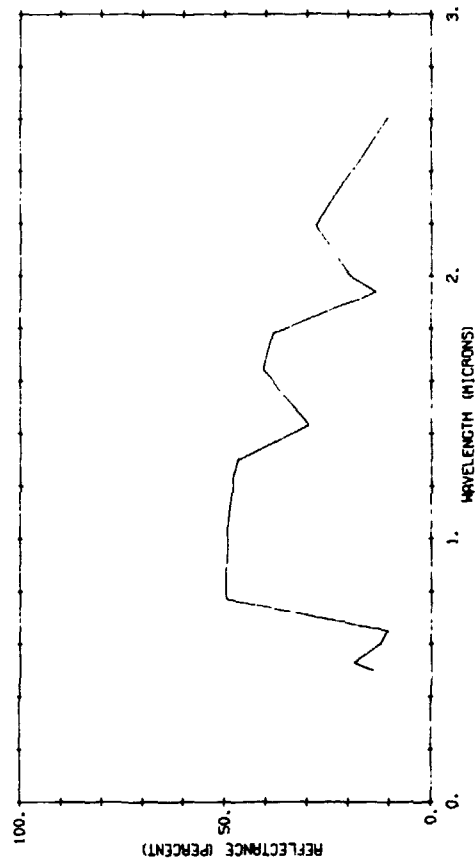
809007 073

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



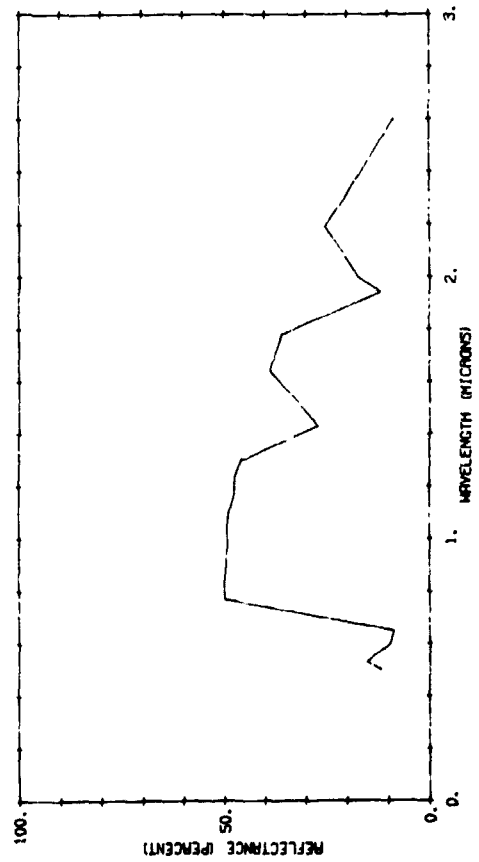
809007 074

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



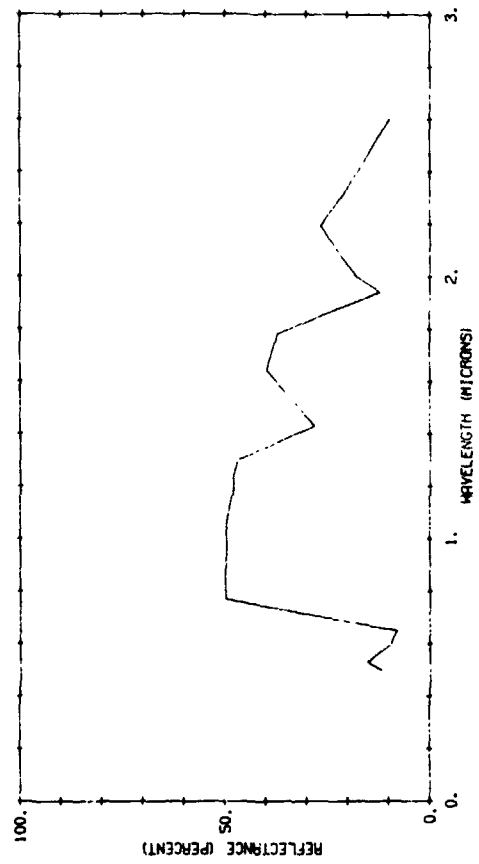
809007 075

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



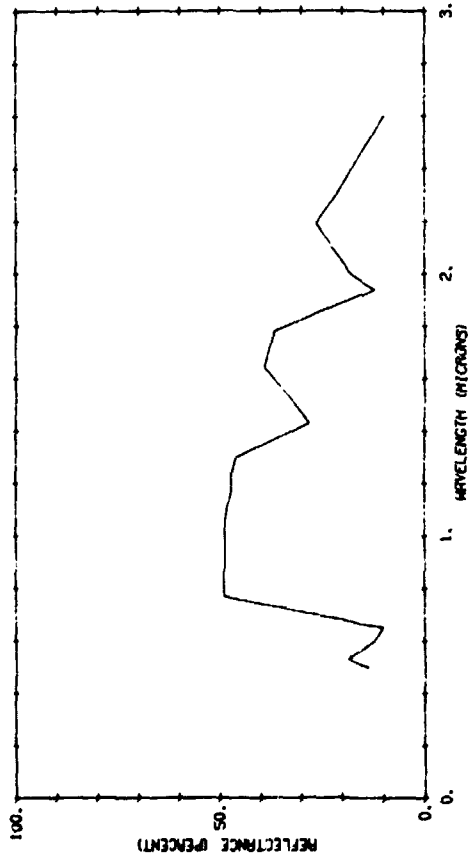
809007 076

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



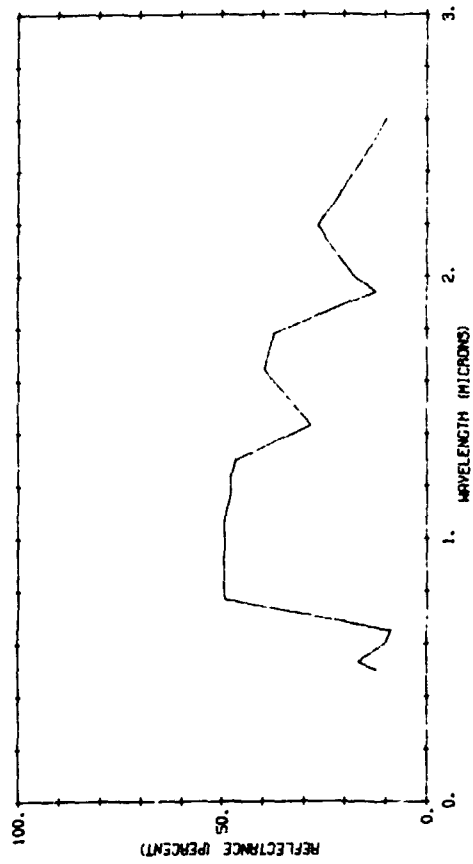
BC9007 U77

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



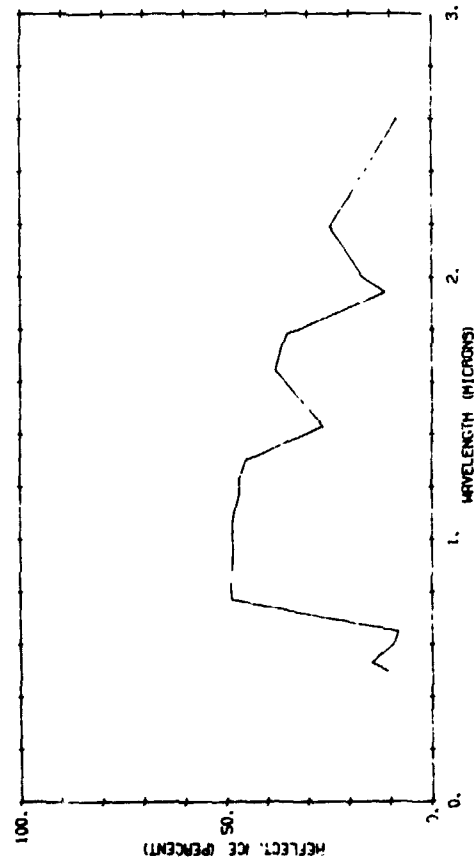
B09007 078

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



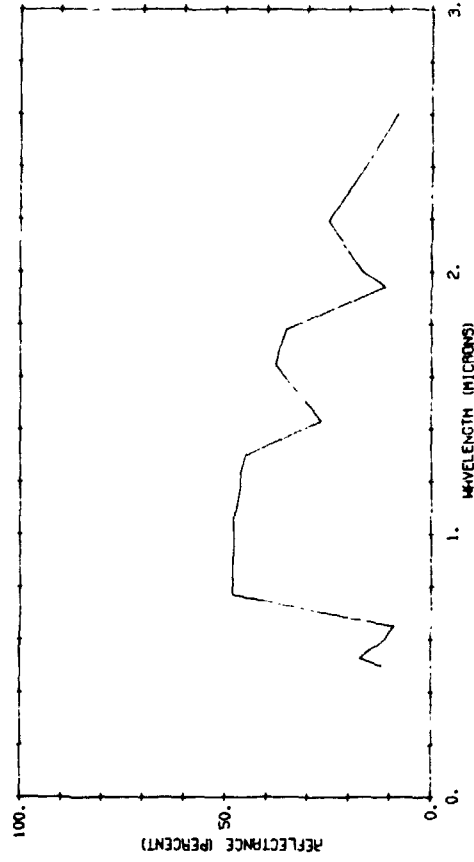
B09007 079

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



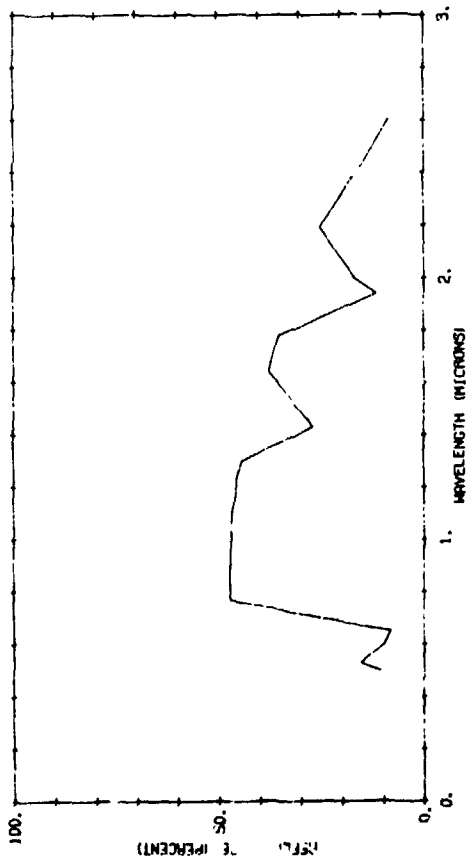
B09007 080

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



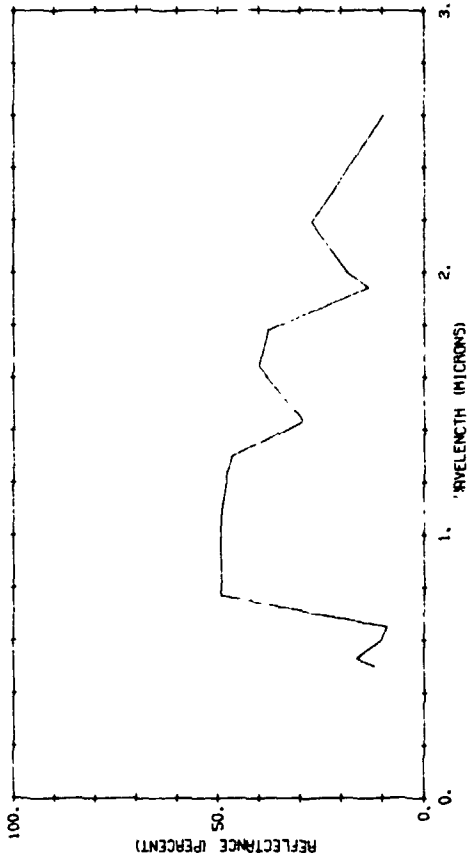
809007 081

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



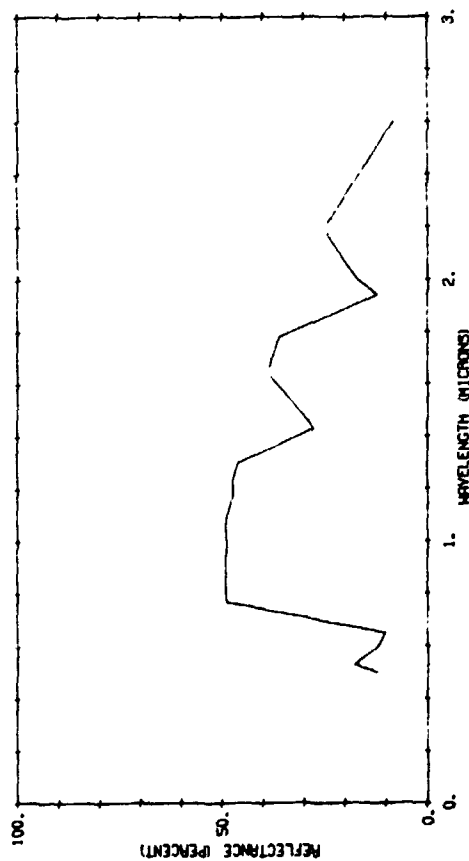
809007 082

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



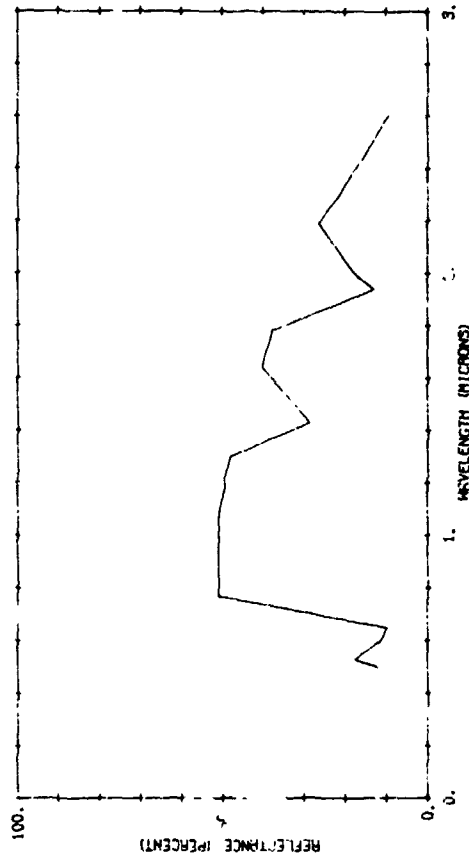
809007 083

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



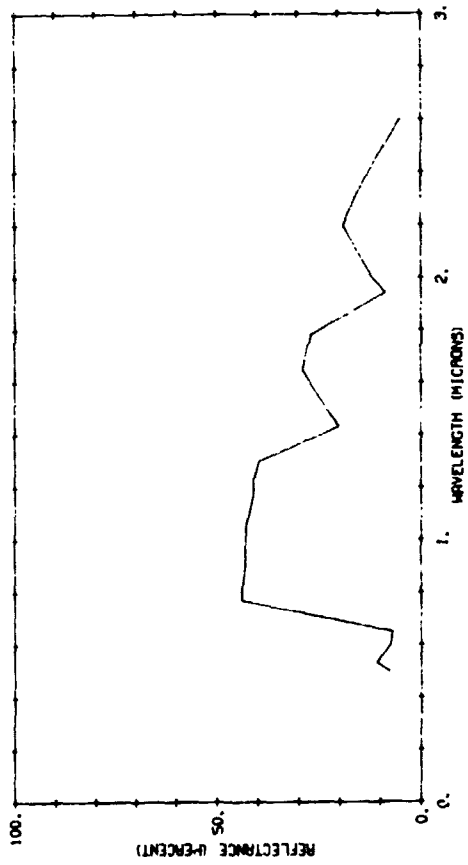
809007 084

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



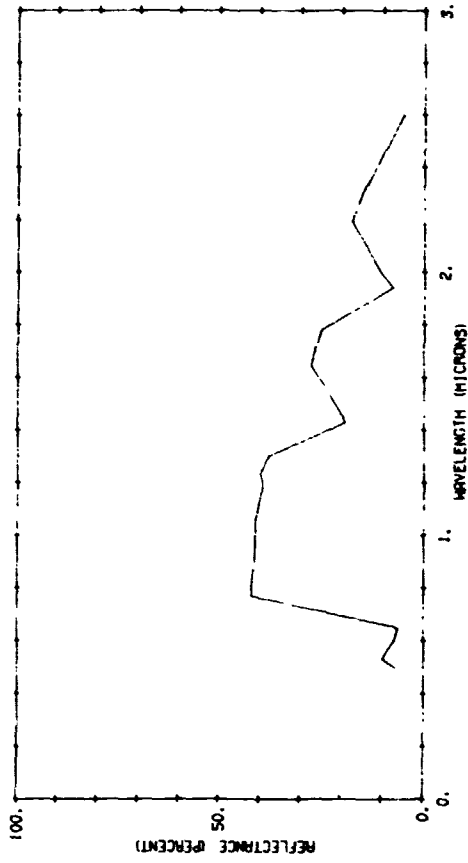
809007 085

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



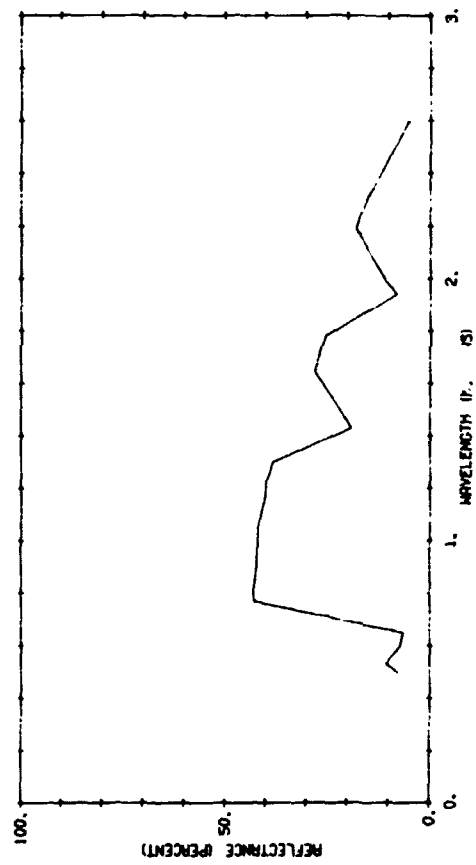
809007 086

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



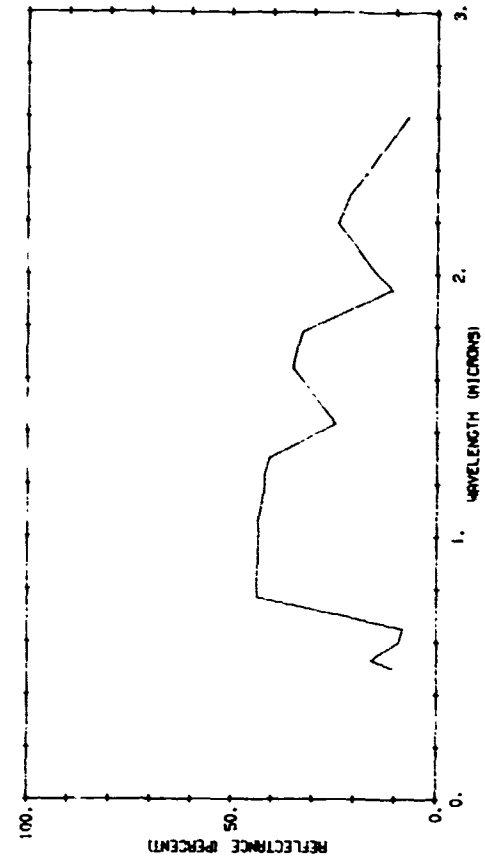
809007 087

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



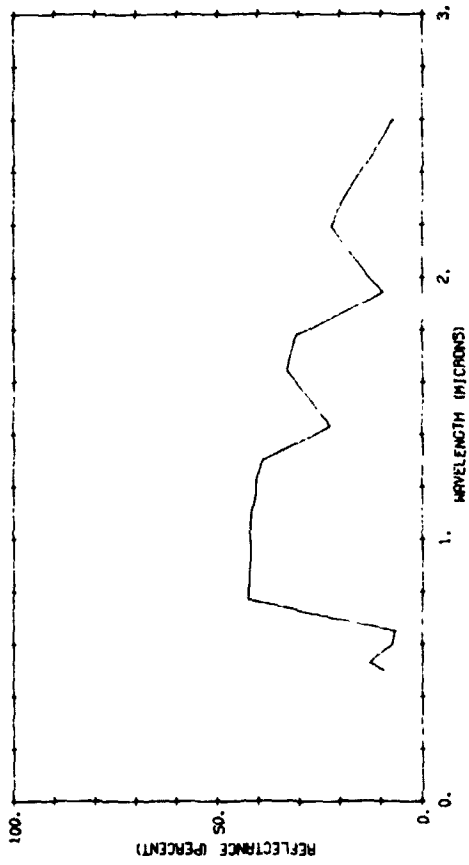
809007 088

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



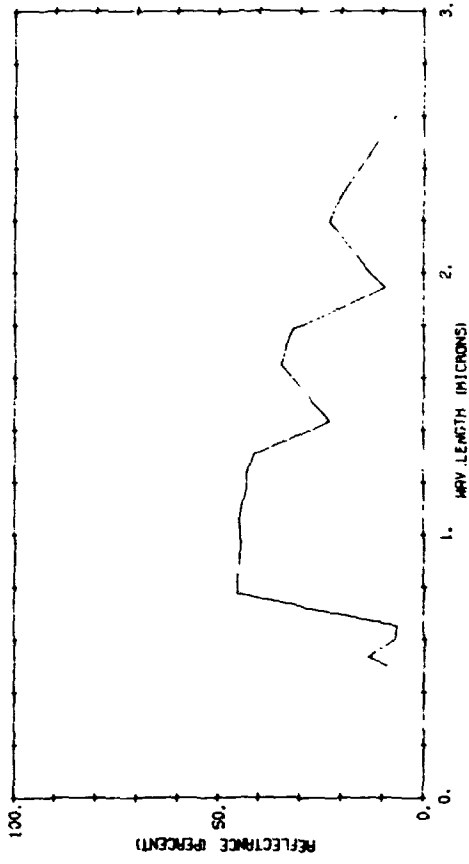
B09007 089

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



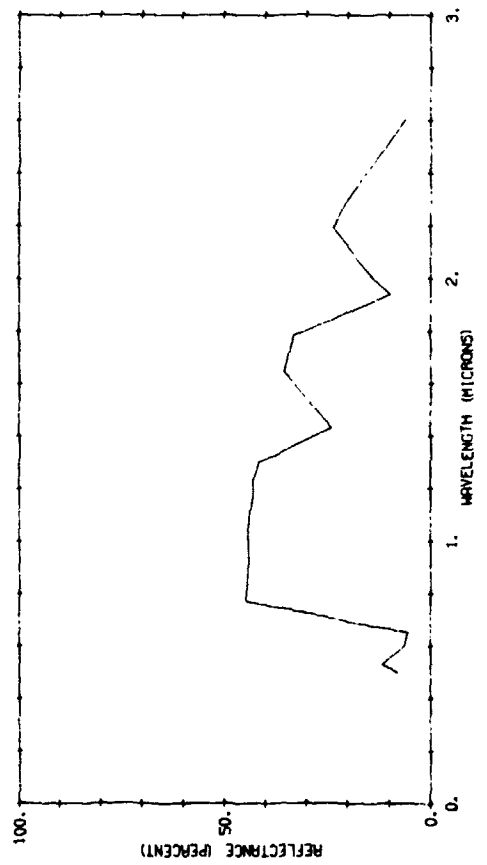
B09007 090

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



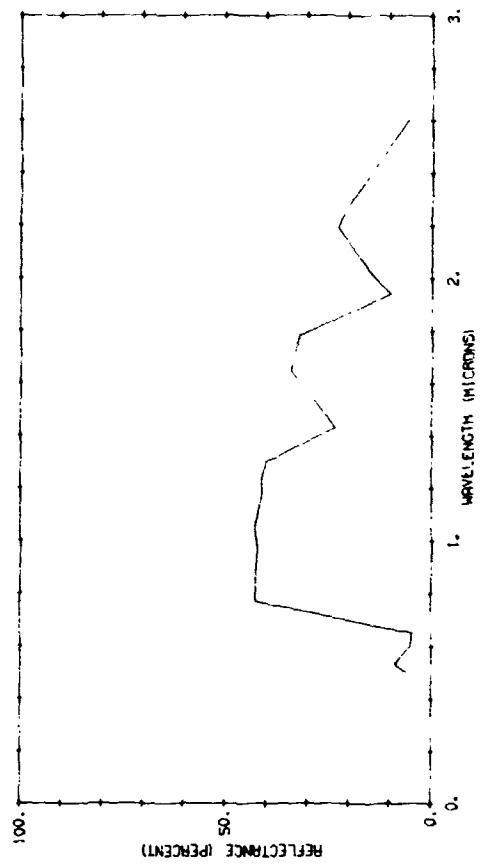
B09007 091

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



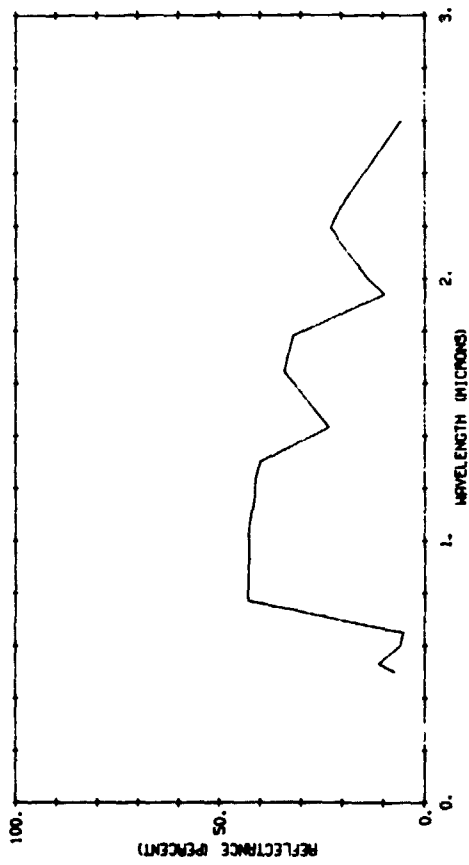
B09007 092

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



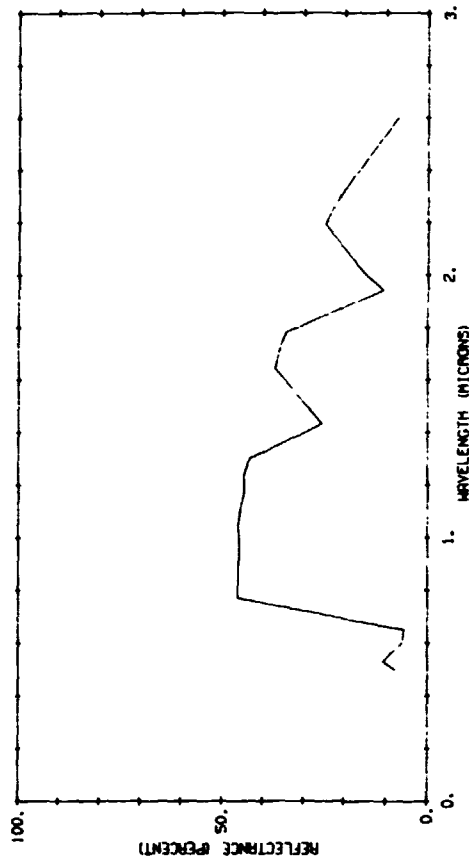
B09007 093

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



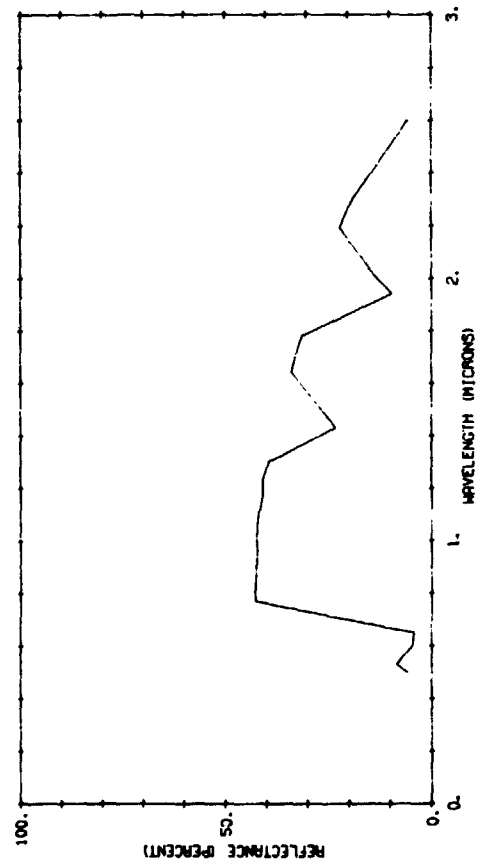
B09007 094

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



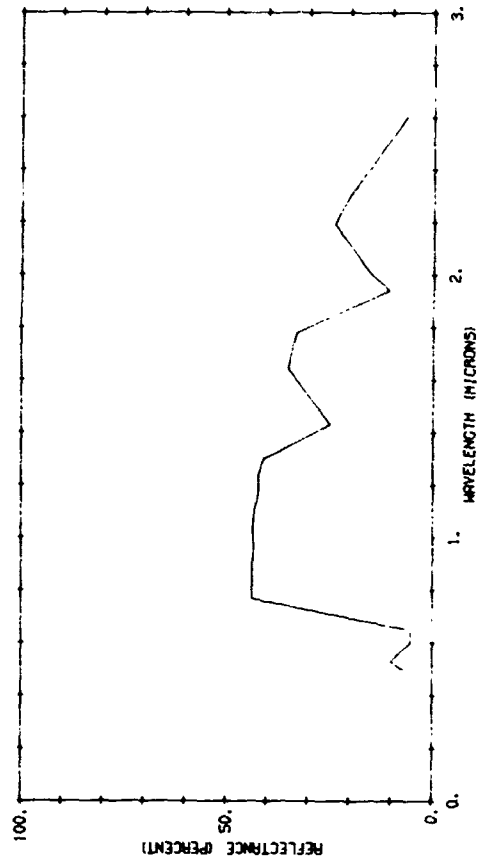
B09007 095

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



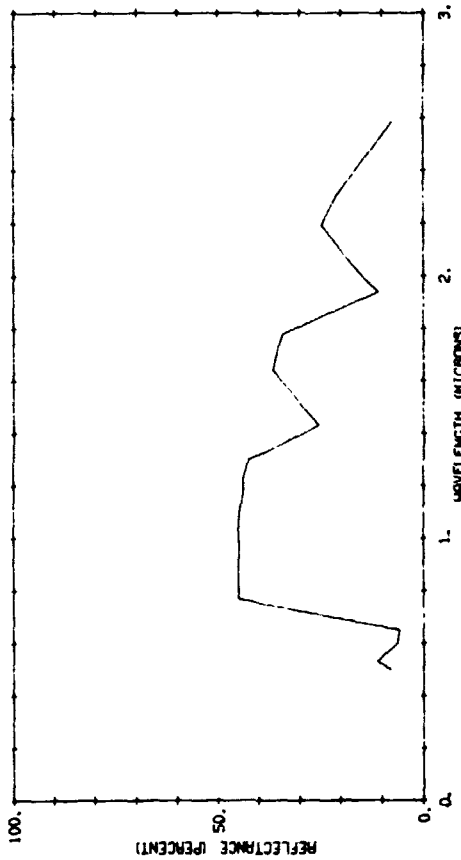
B09007 096

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



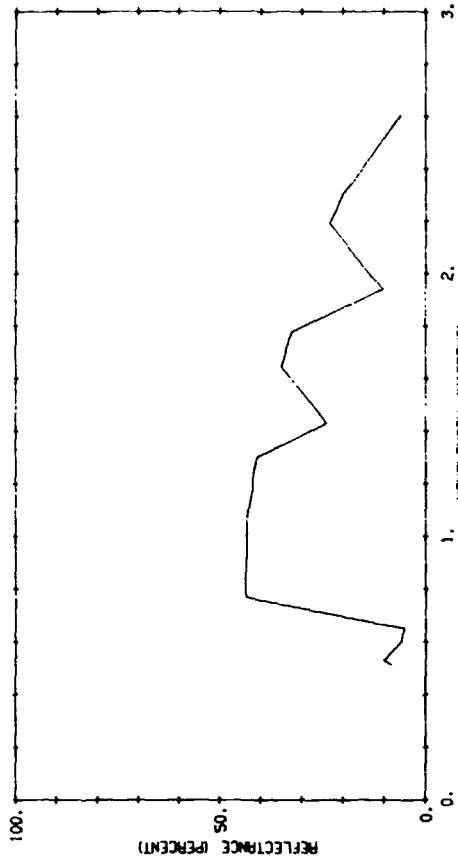
809007 097

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



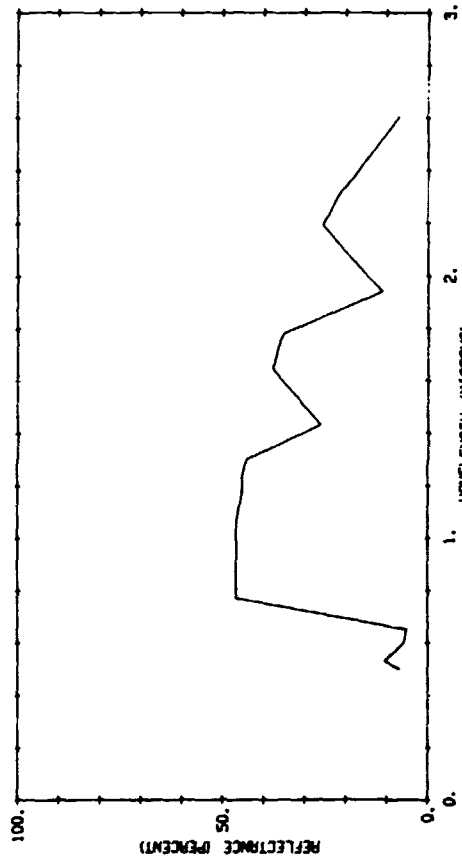
809007 098

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



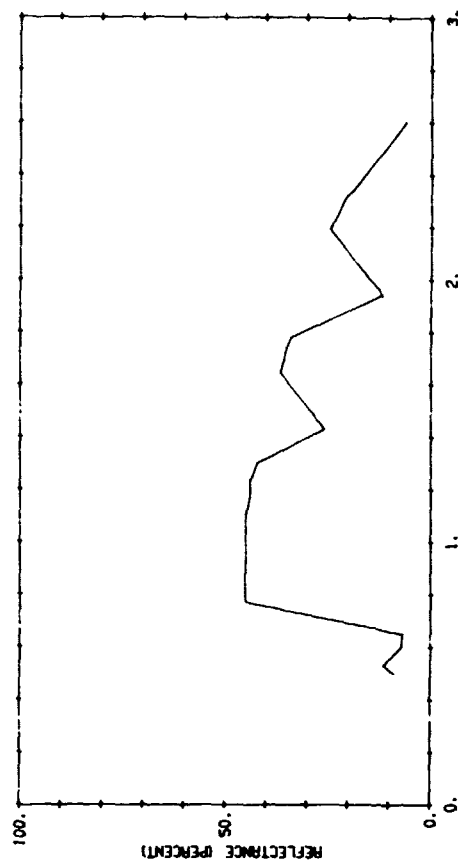
809007 099

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



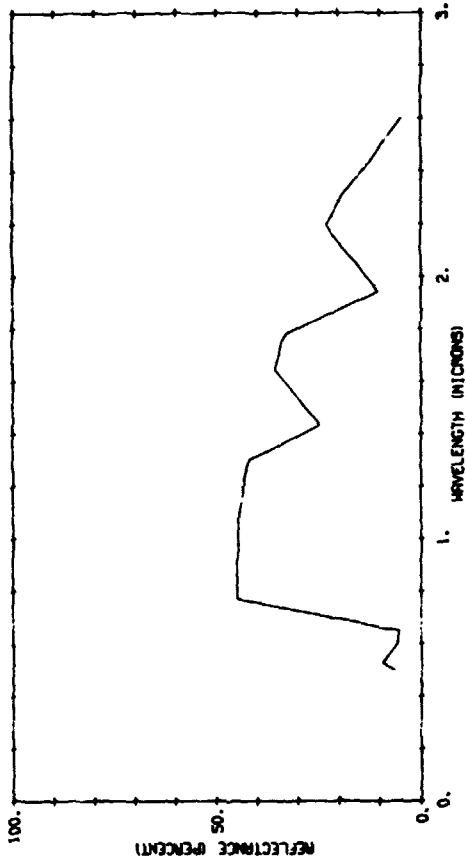
809007 100

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



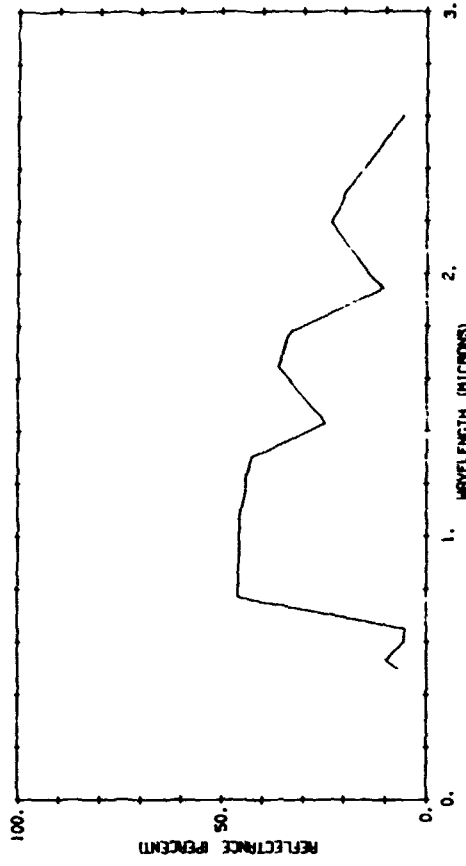
809007 101

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



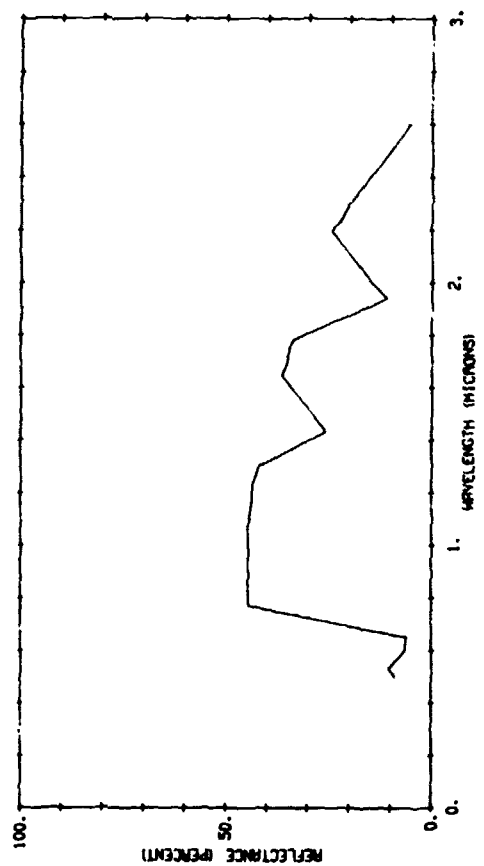
809007 102

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



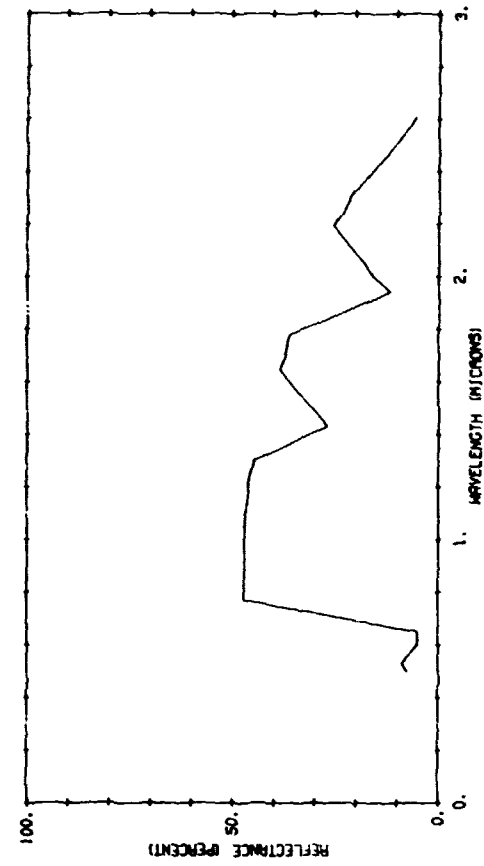
809007 103

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



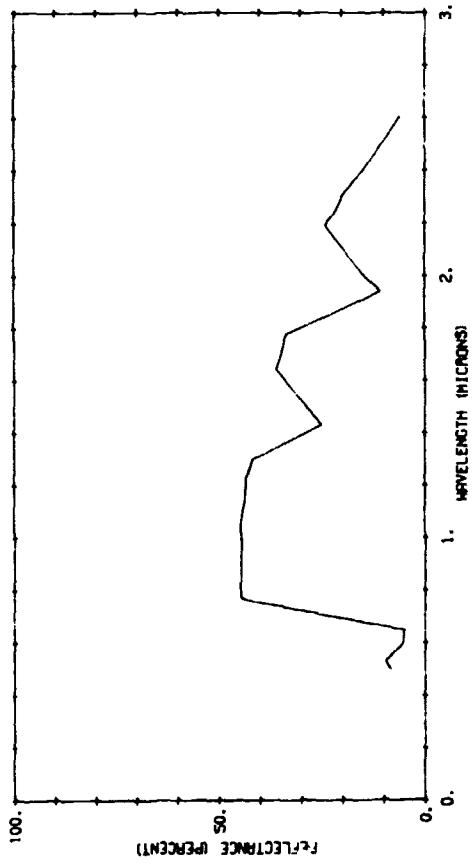
809007 104

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



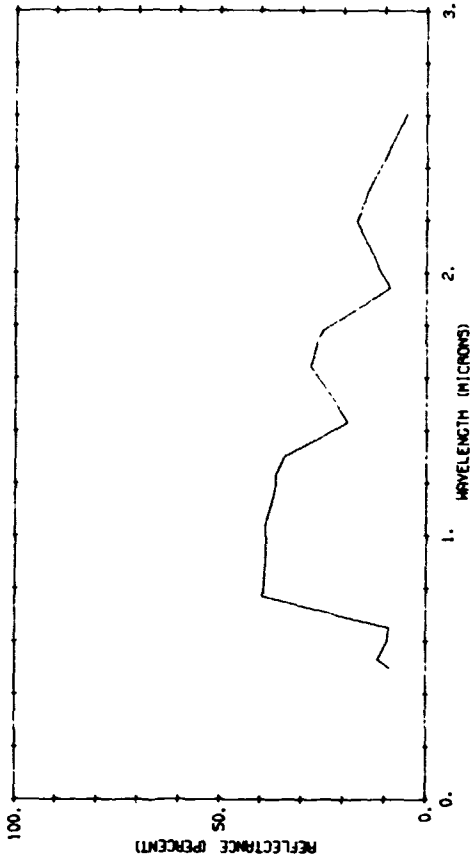
B09007 105

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



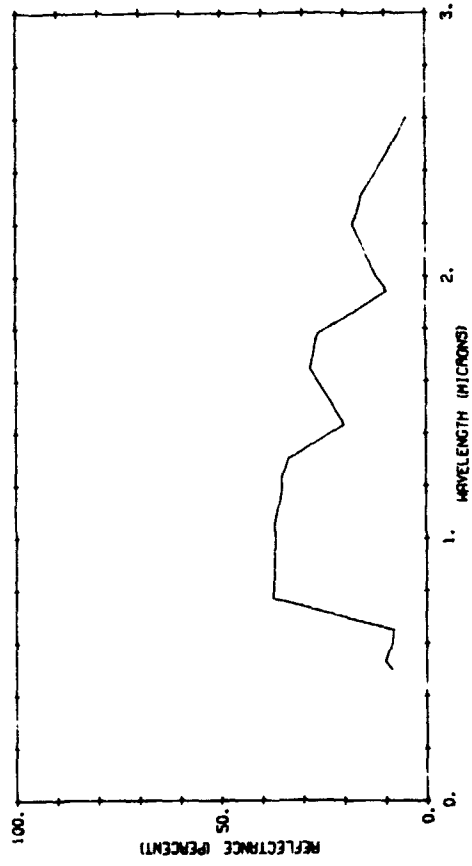
B09007 106

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



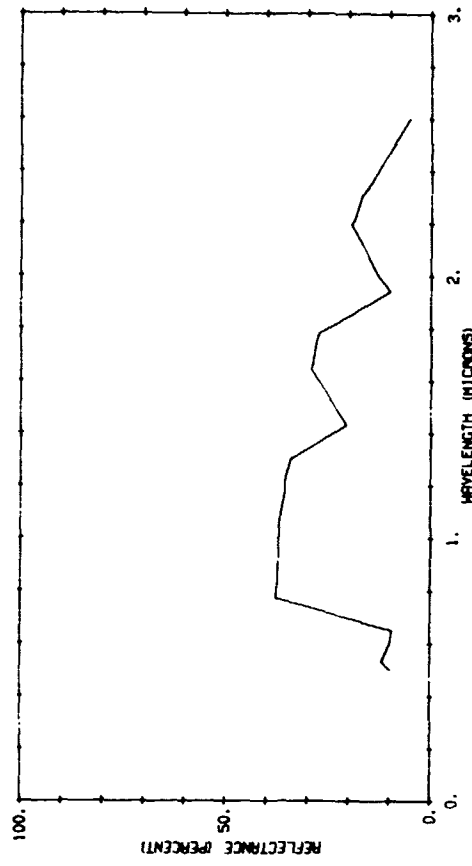
B09007 107

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



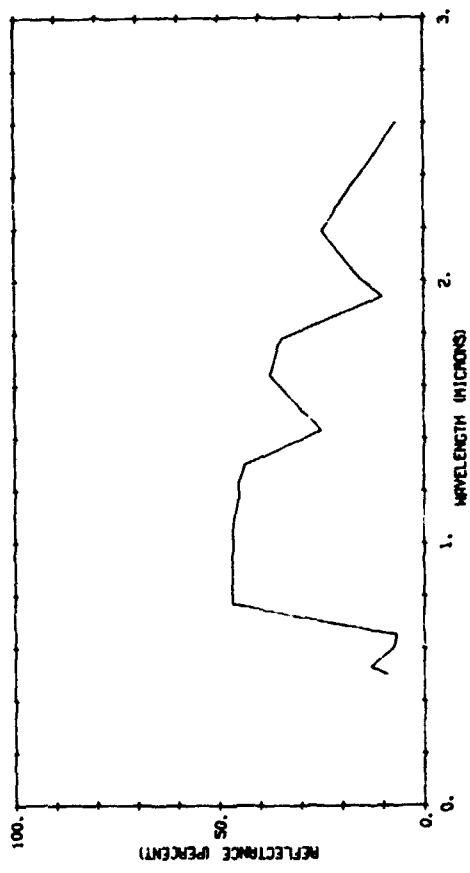
B09007 108

TREE 3, LEAF 6. LEAF FROM SECOND FLUSH OF SEASON.



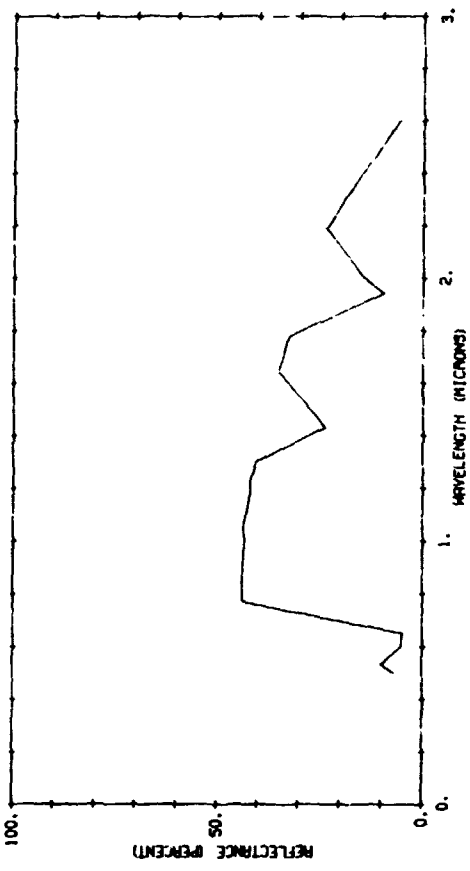
809007 109

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



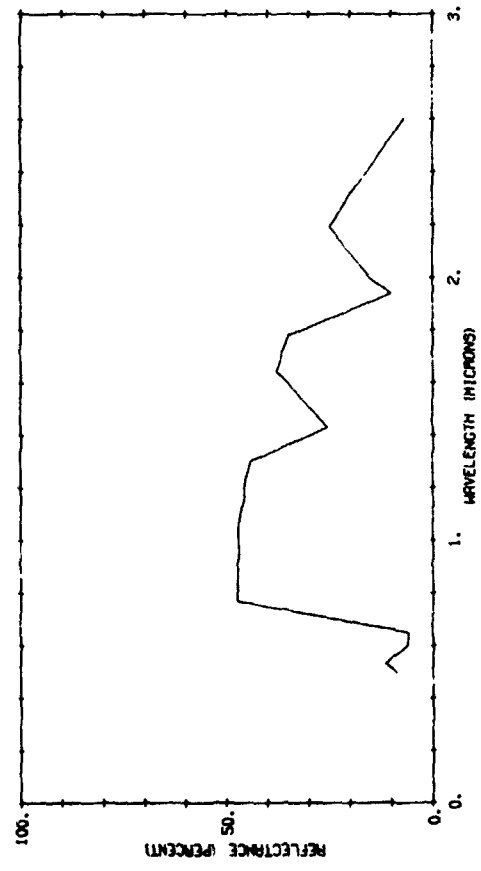
809007 110

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



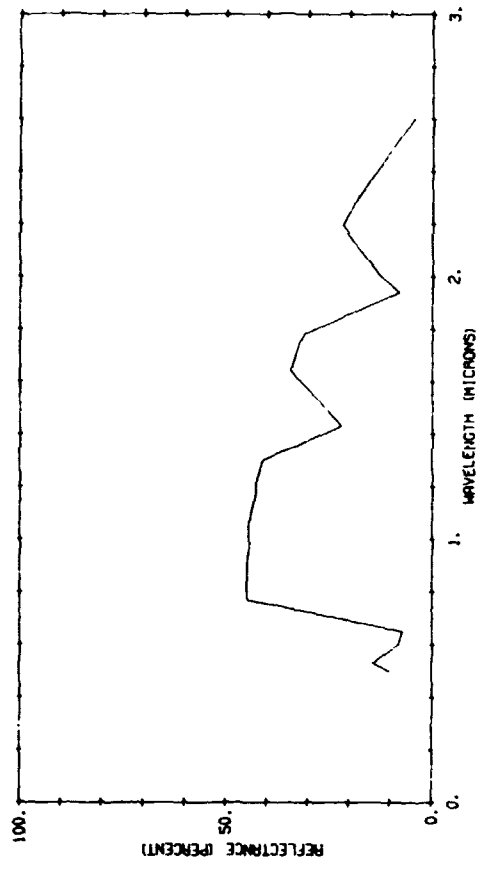
809007 111

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



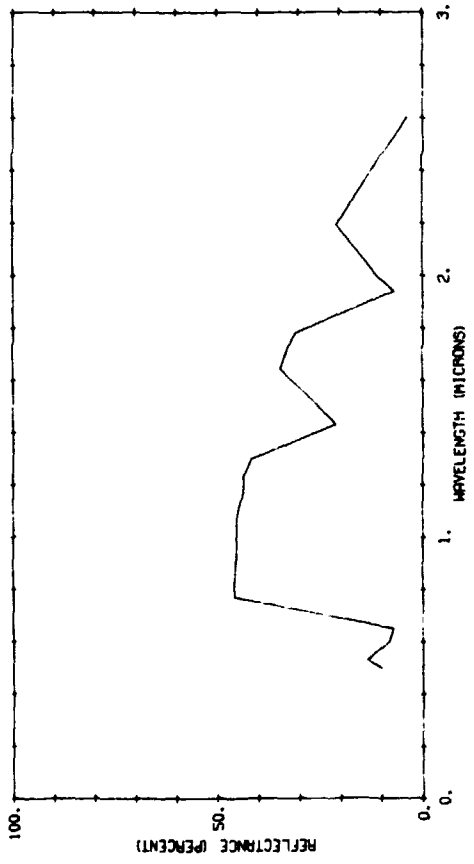
809007 112

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



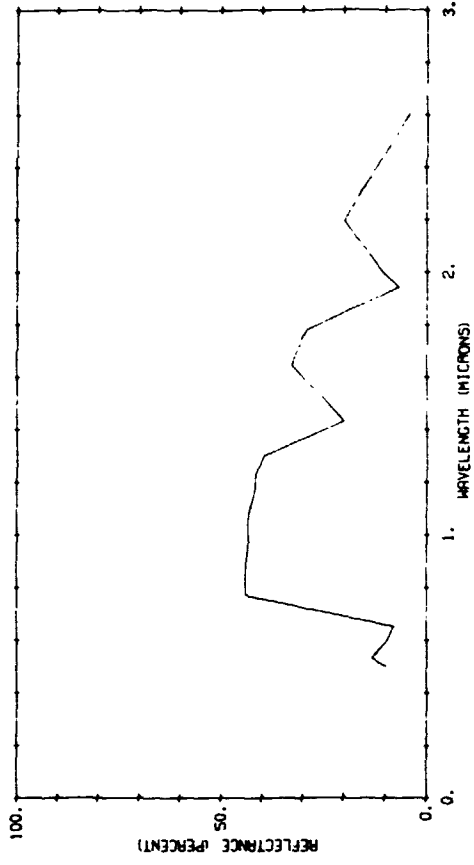
809007 113

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



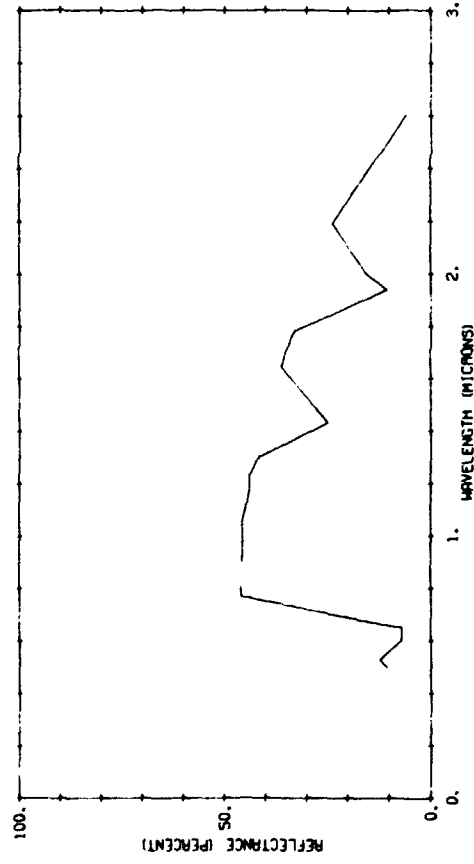
809007 114

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



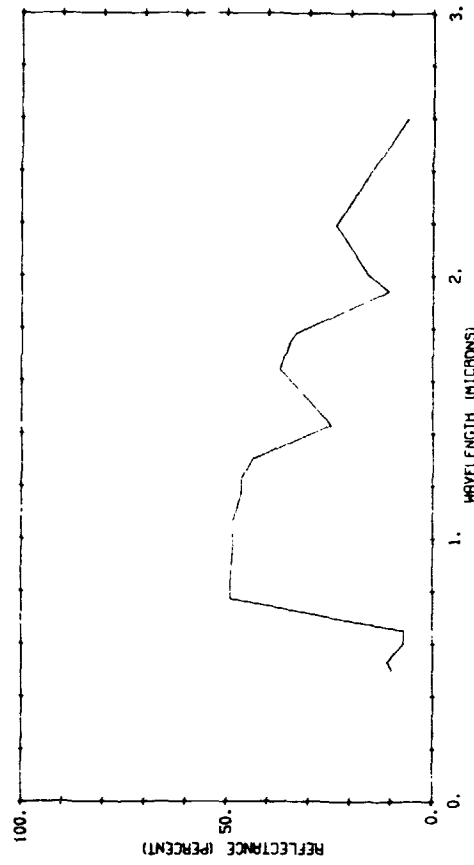
809007 115

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



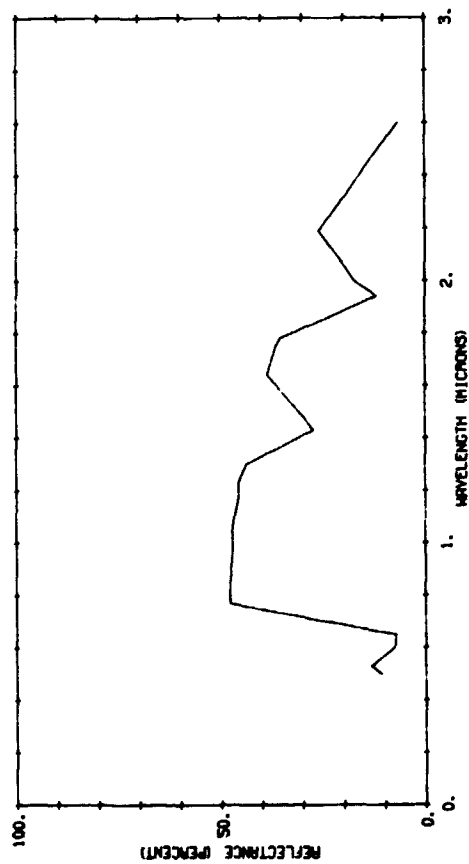
809007 116

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



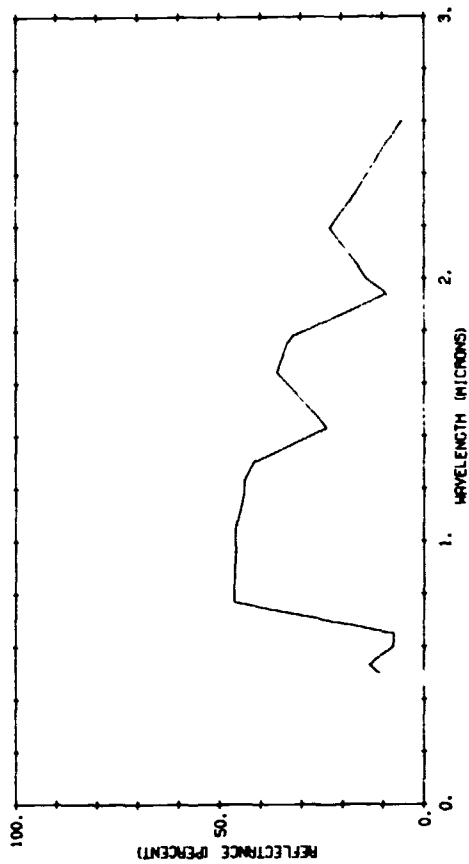
B09007 117

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



B09007 118

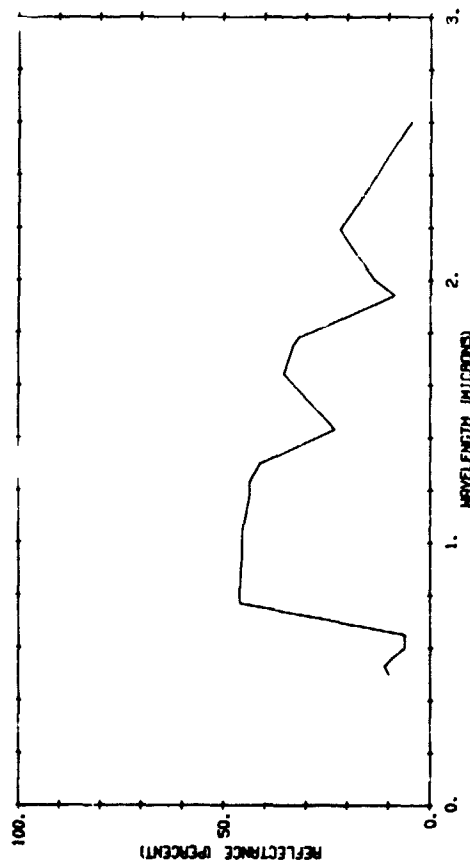
TREE 3, LEAF 4. WATERED EVERY SECOND OR THIRD DAY.
LEAF FROM SECOND FLUSH OF SEASON.



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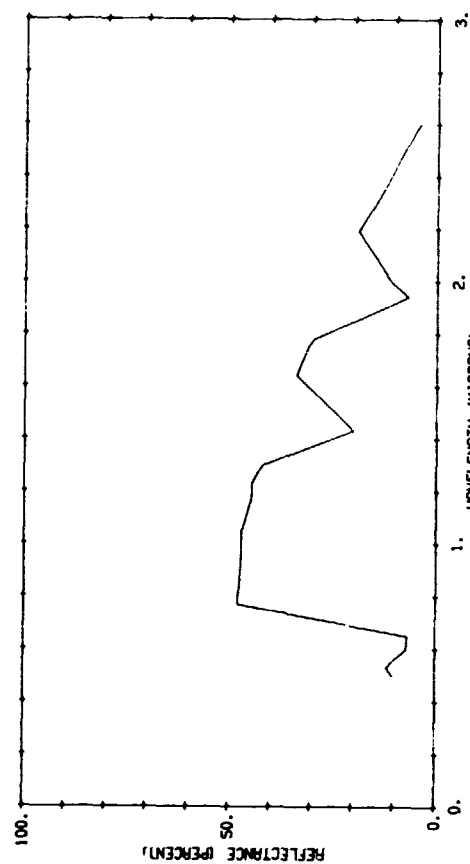
B09007 119

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



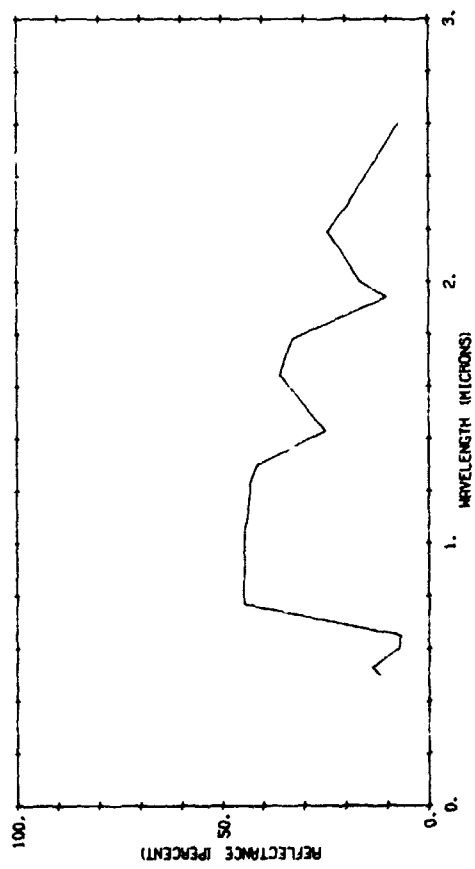
B09007 120

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



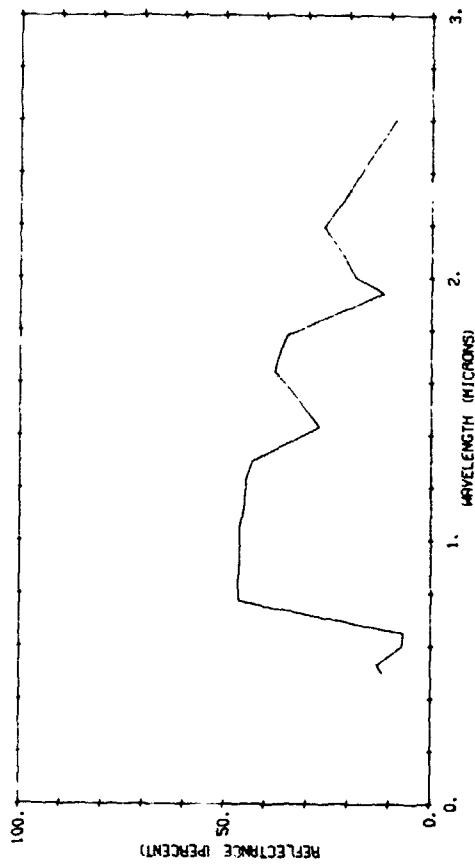
B09007 121

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



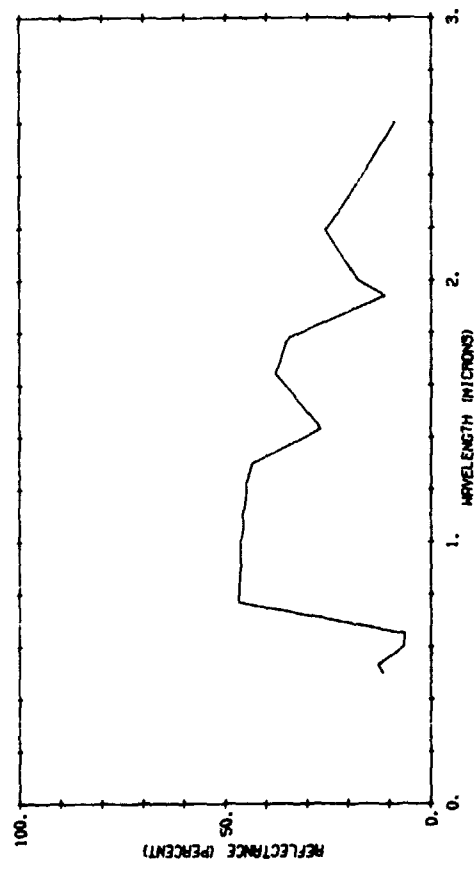
B09007 122

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



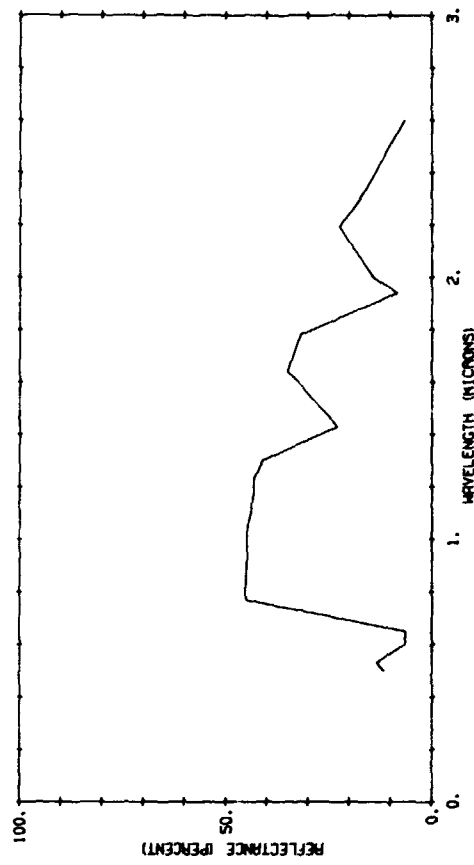
B09007 123

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



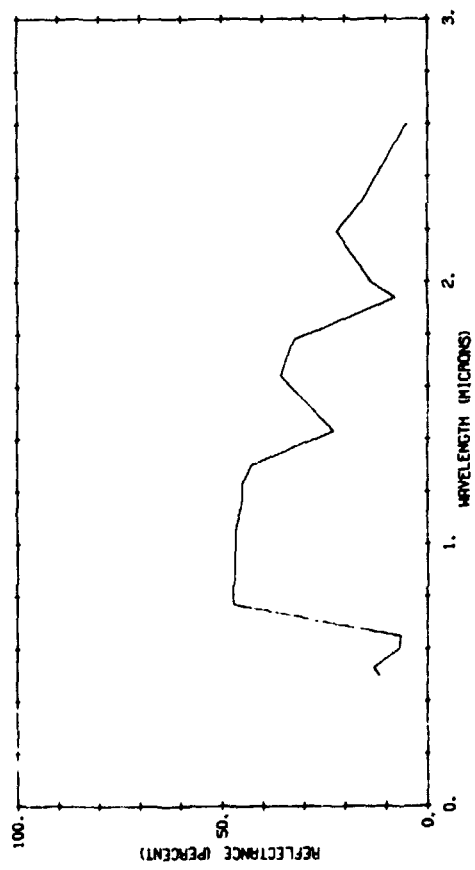
B09007 124

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



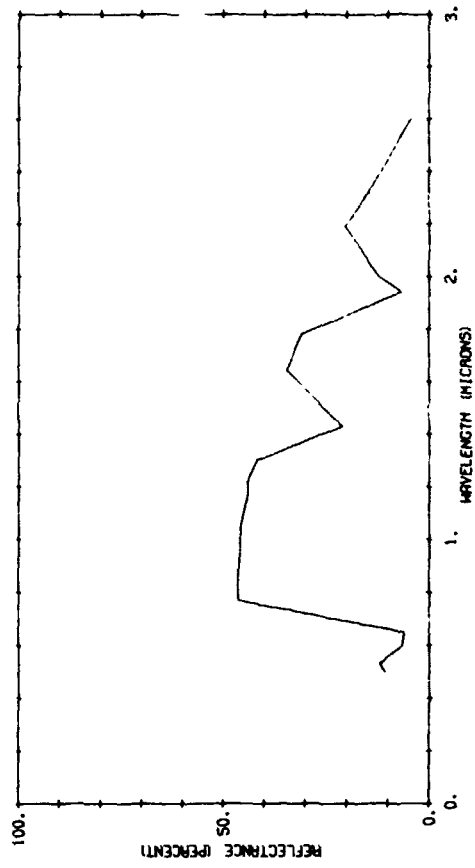
B09007 125

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



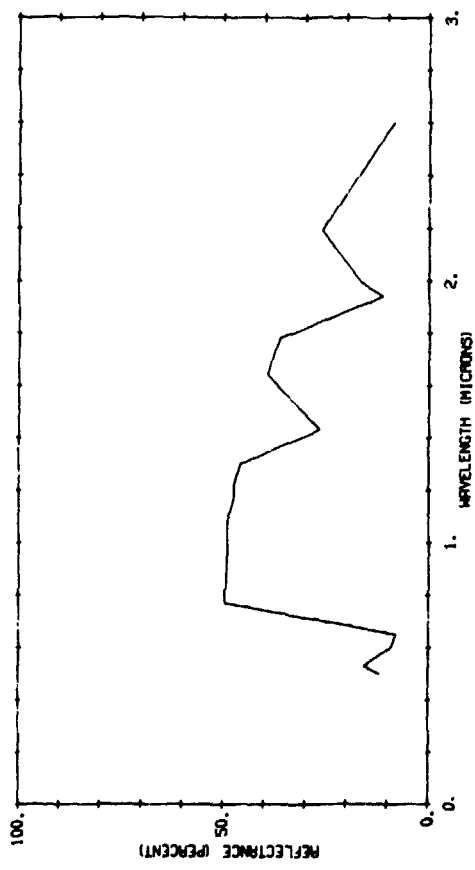
B09007 126

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



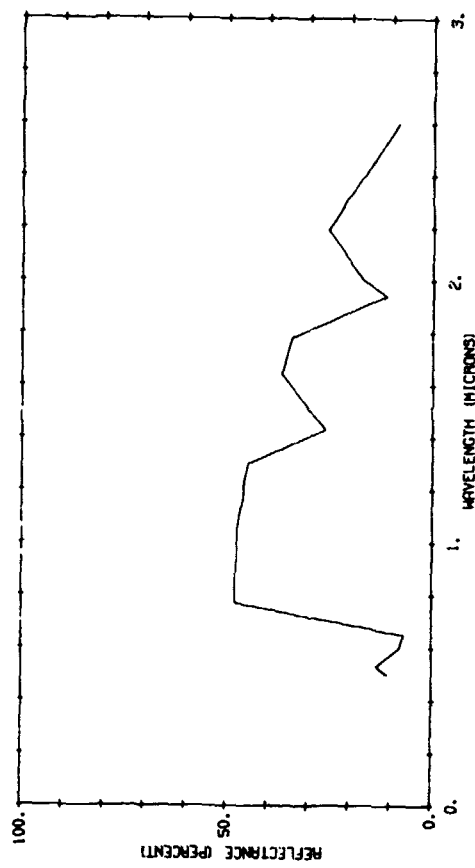
B09007 127

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



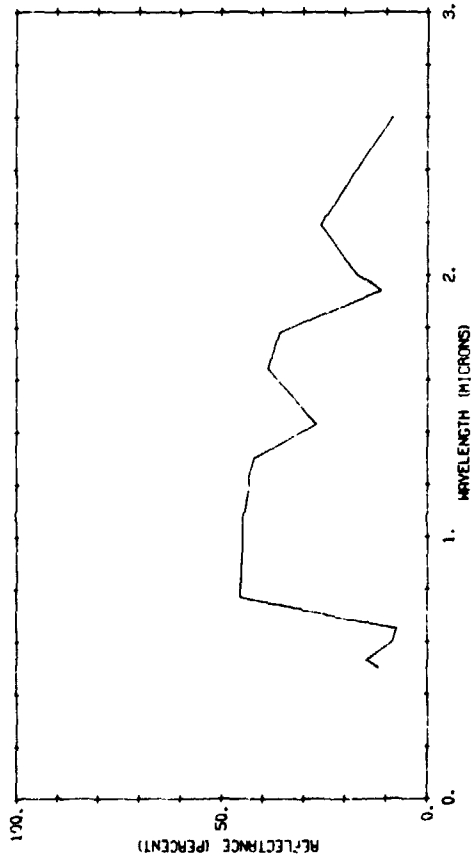
B09007 128

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



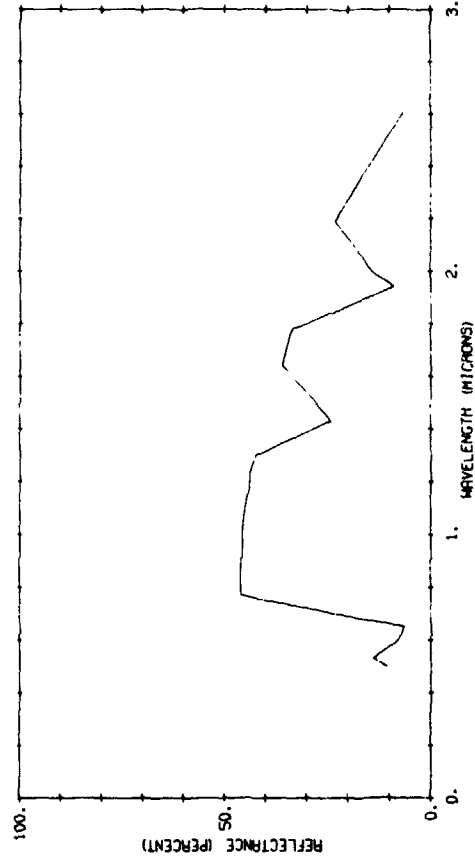
809007 129

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



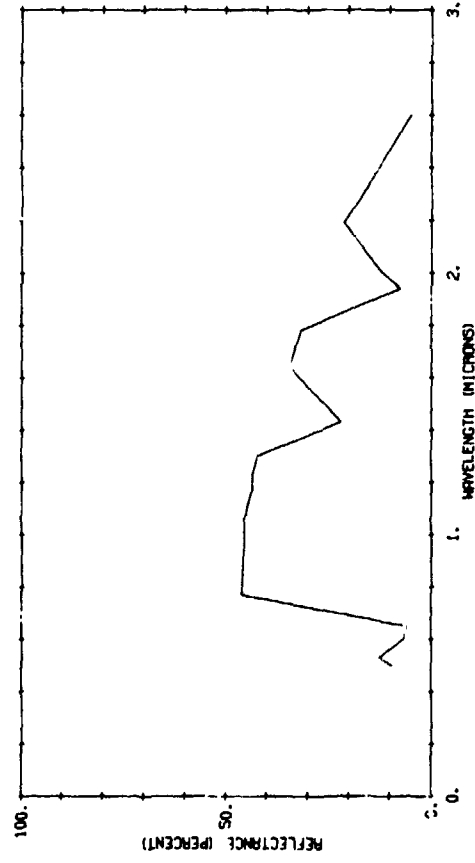
809007 130

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



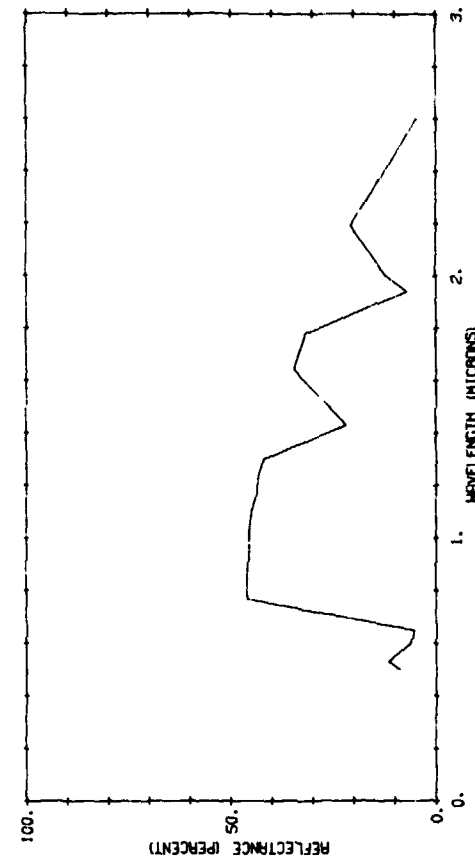
809007 131

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



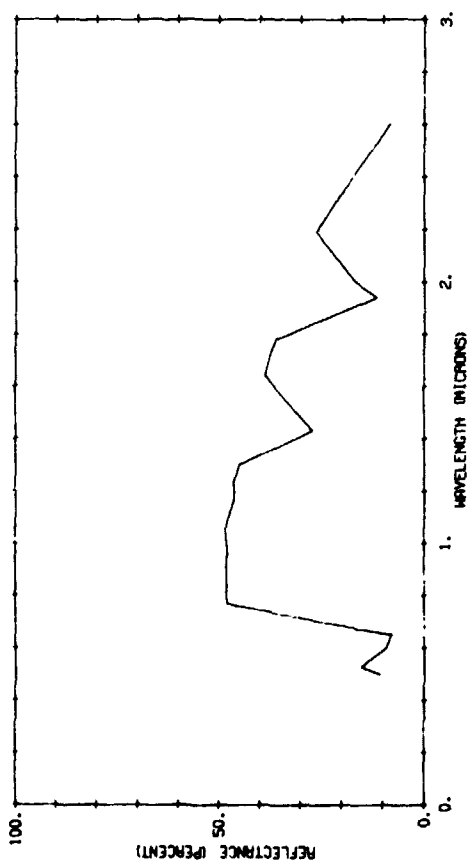
809007 132

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



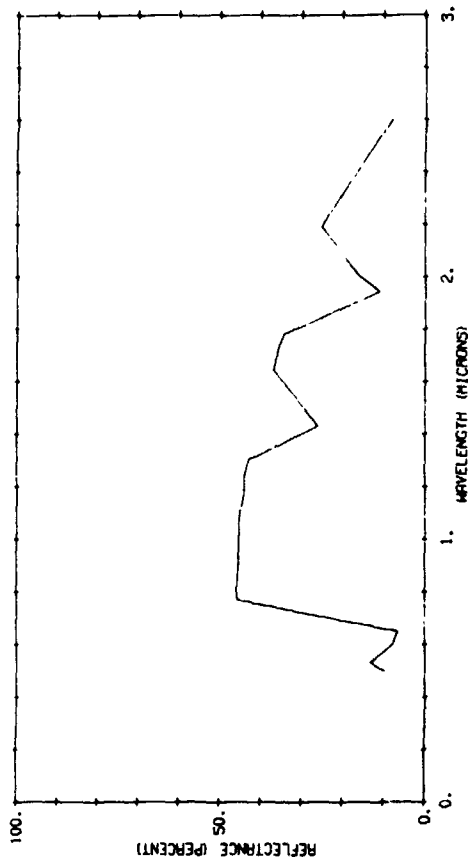
B09007 133

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



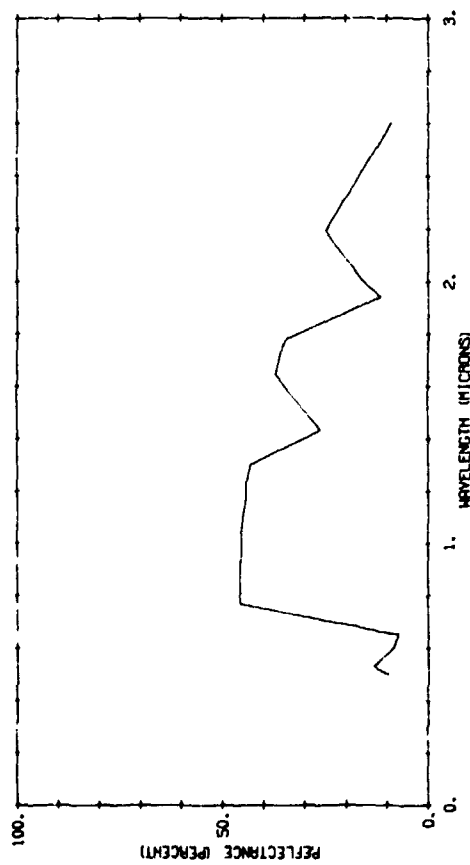
B09007 134

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



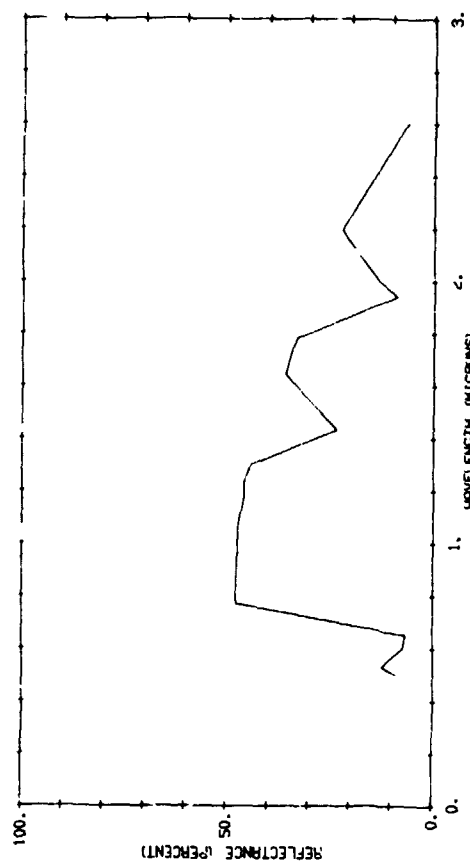
B09007 135

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



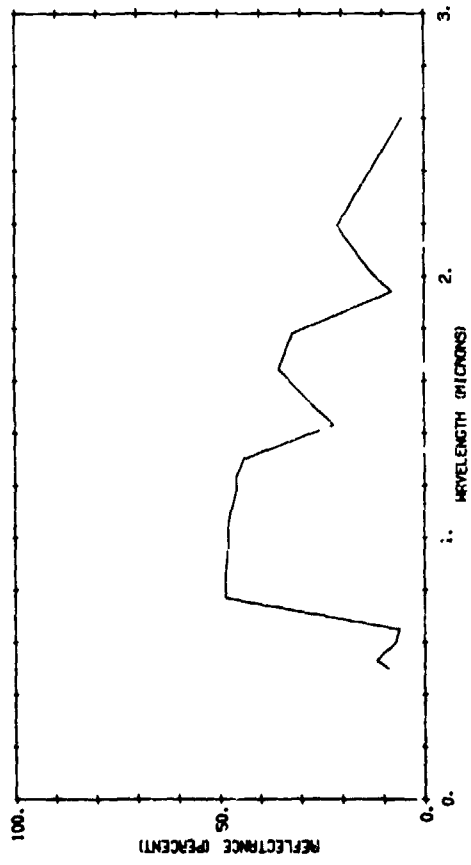
B09007 136

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



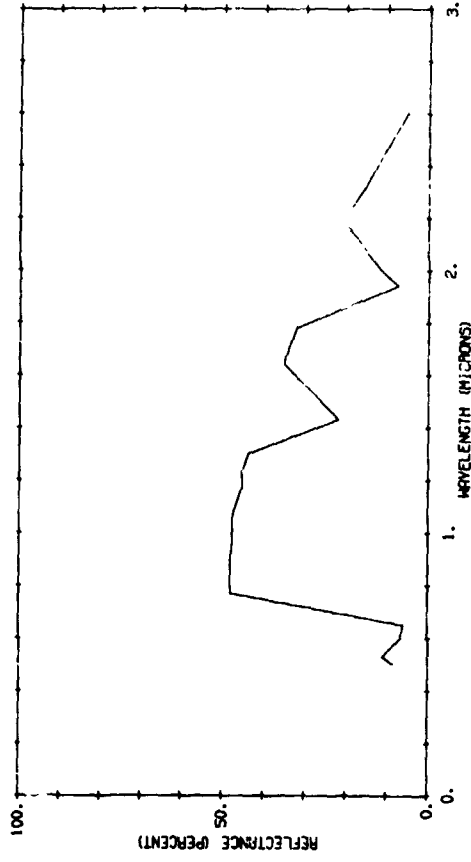
809007 137

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



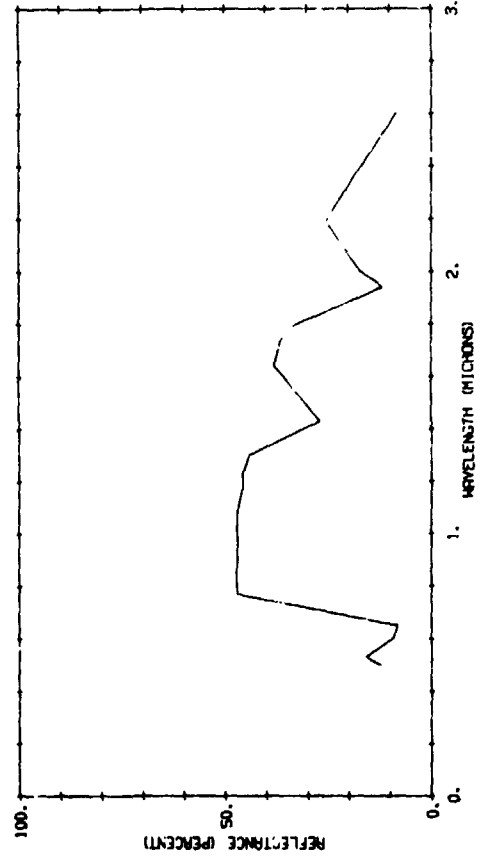
809007 138

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



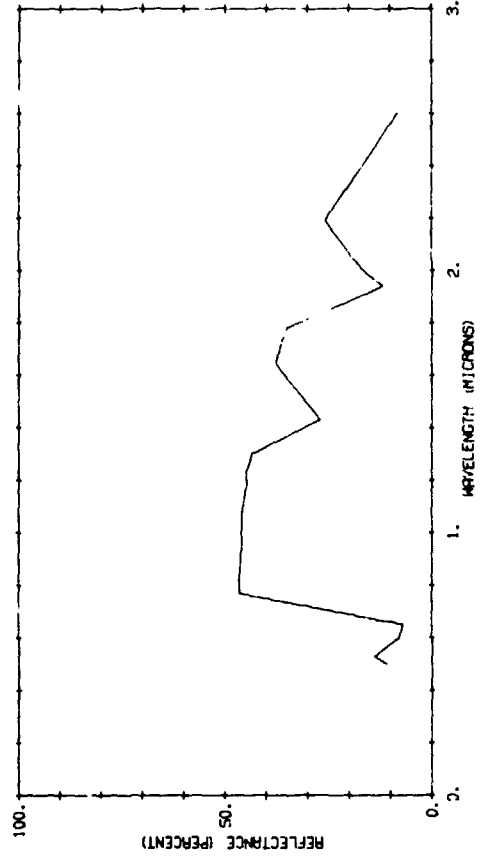
809007 139

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



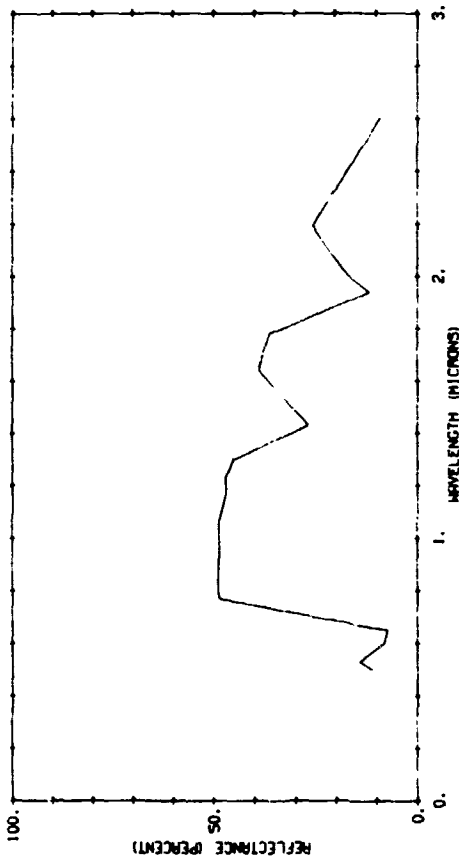
809007 140

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



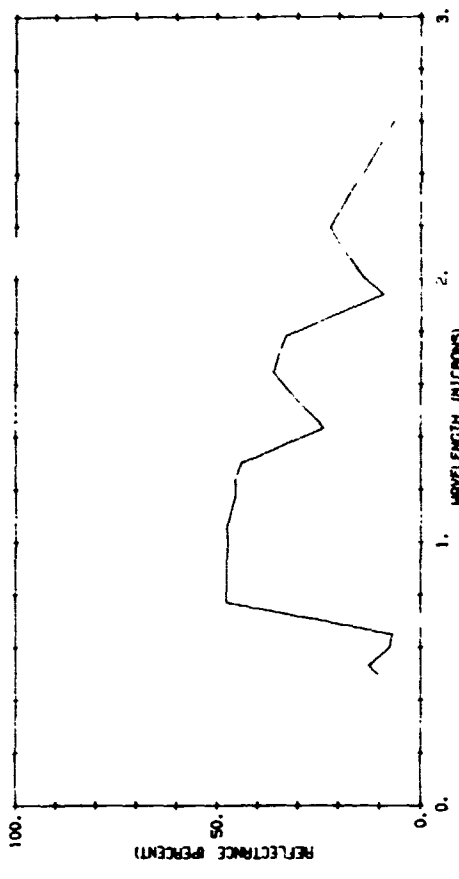
809007 141

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



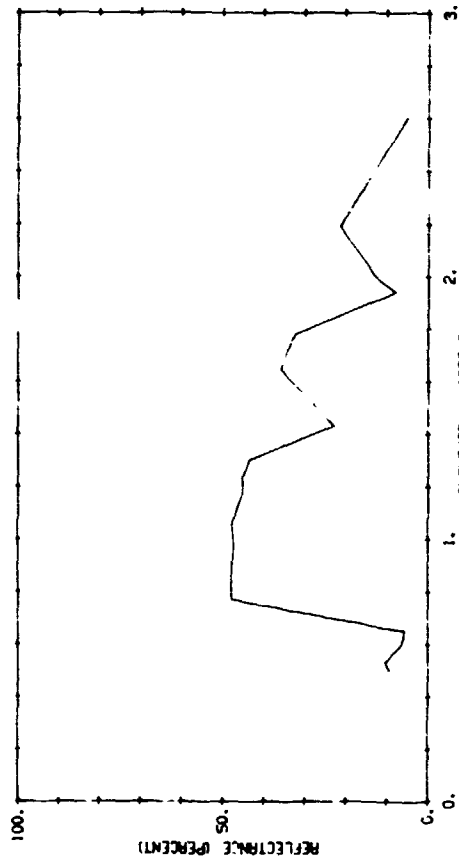
809007 142

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



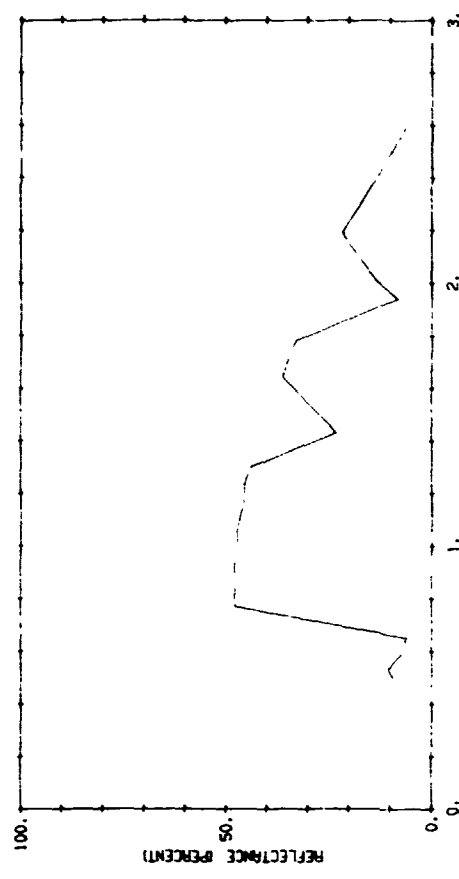
809007 143

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



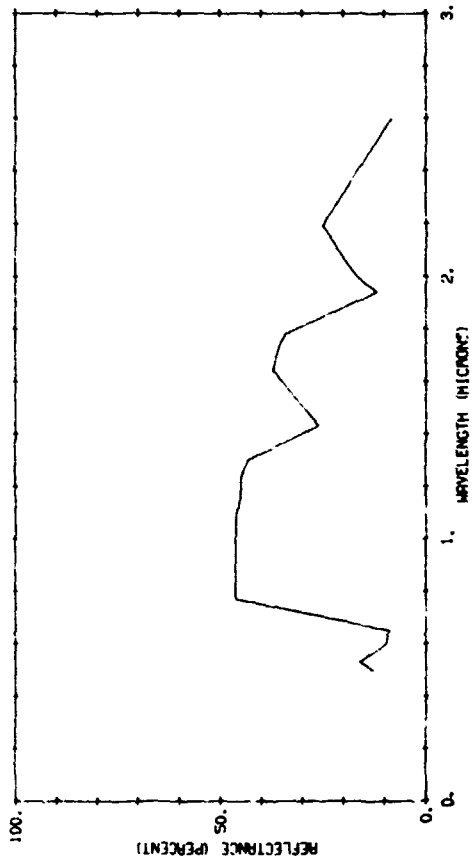
809007 144

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



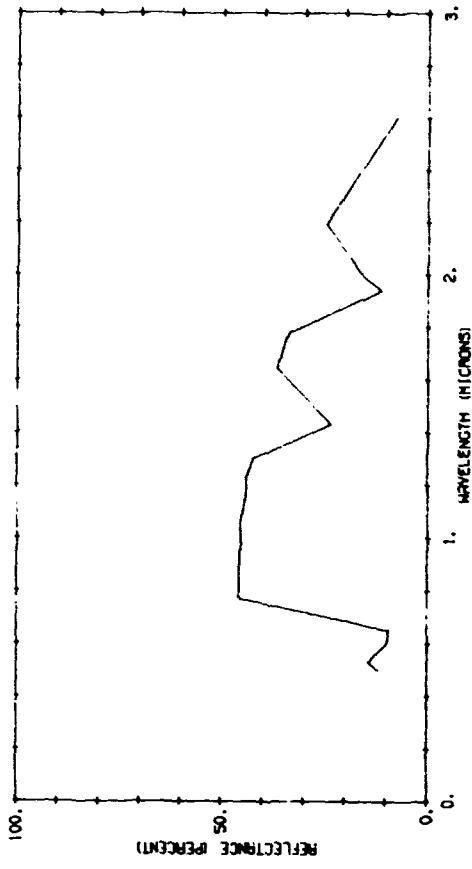
B09007 145

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



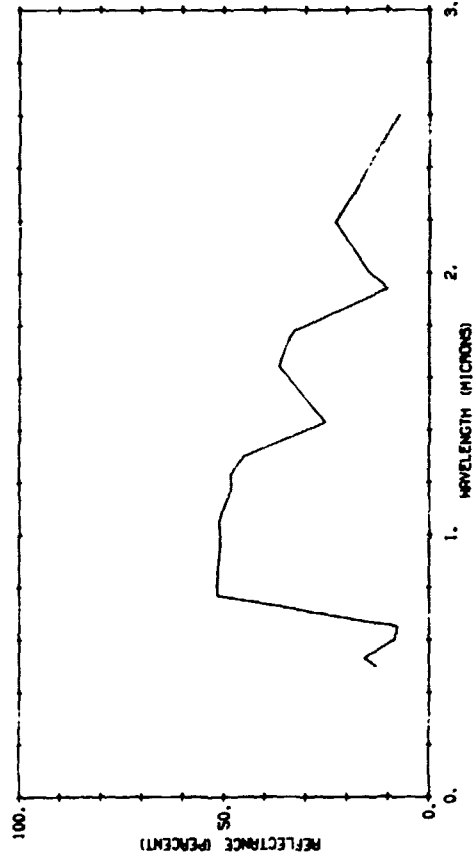
B09007 146

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



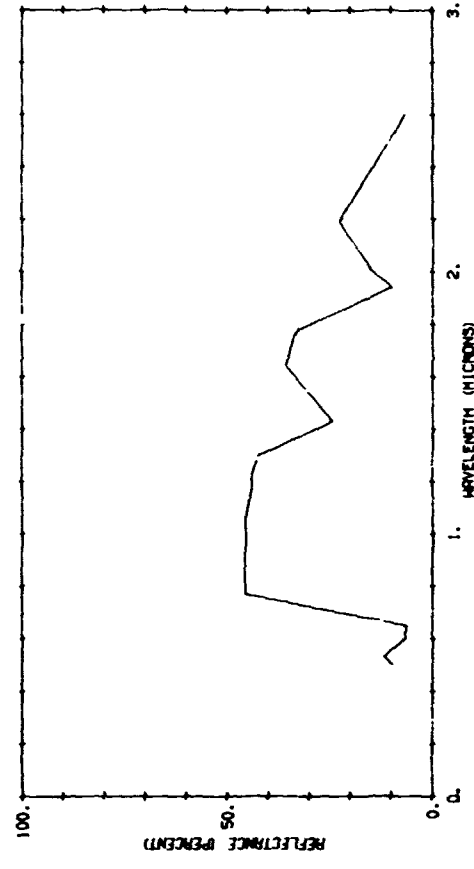
B09007 147

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



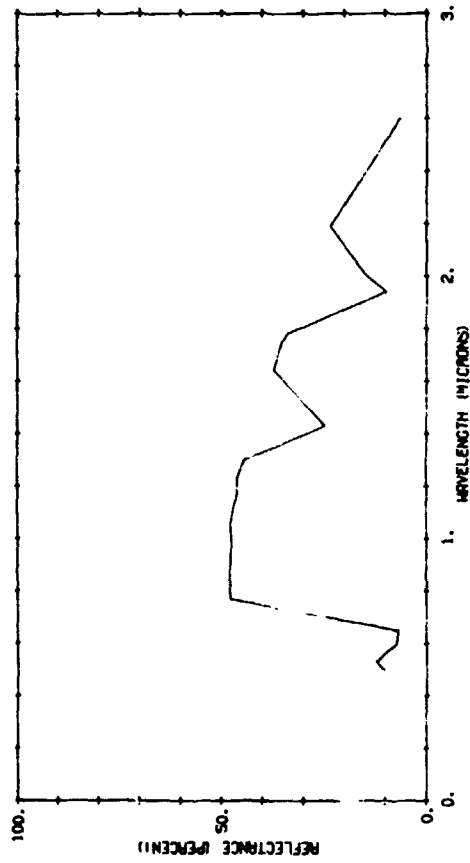
B09007 148

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



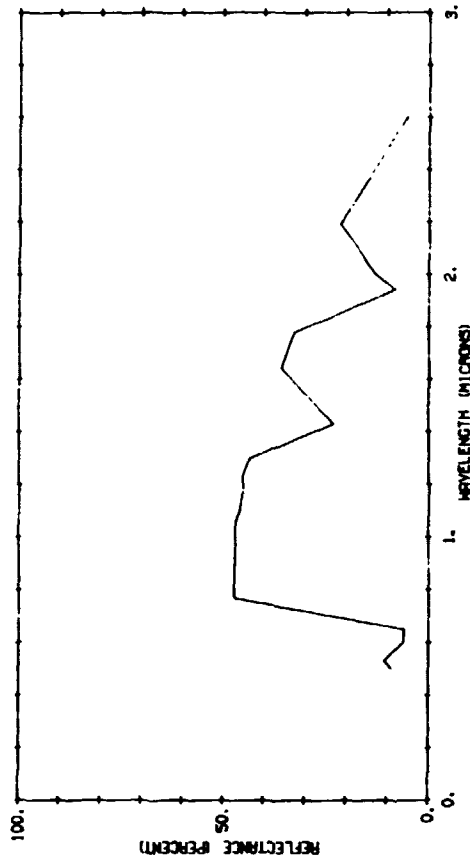
809007 149

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



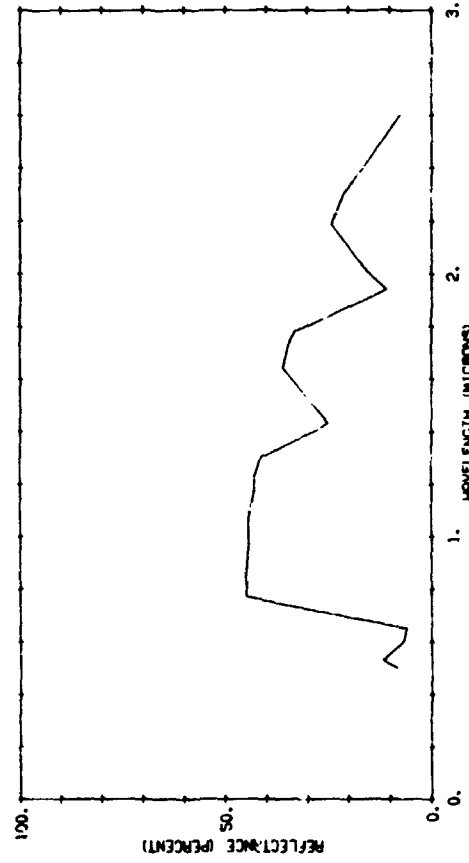
809007 150

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



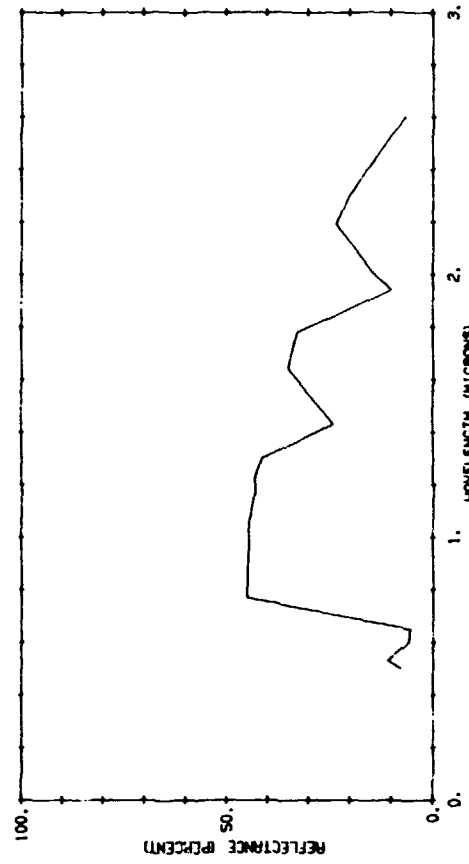
809007 151

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



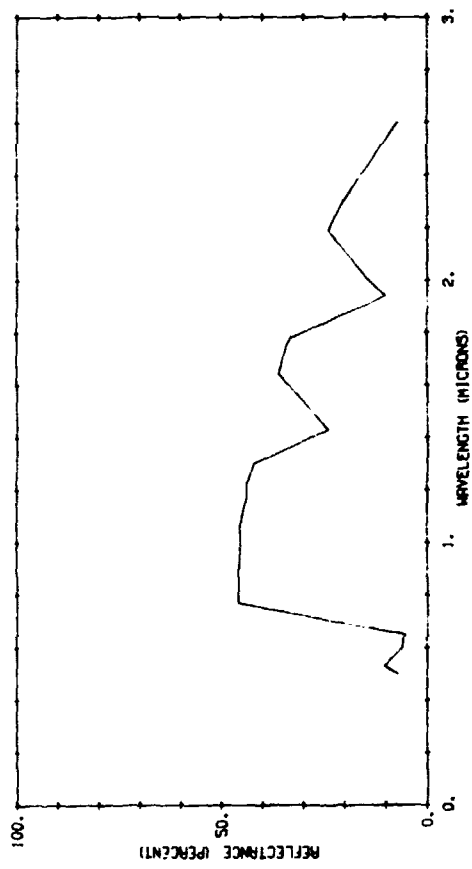
809007 152

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



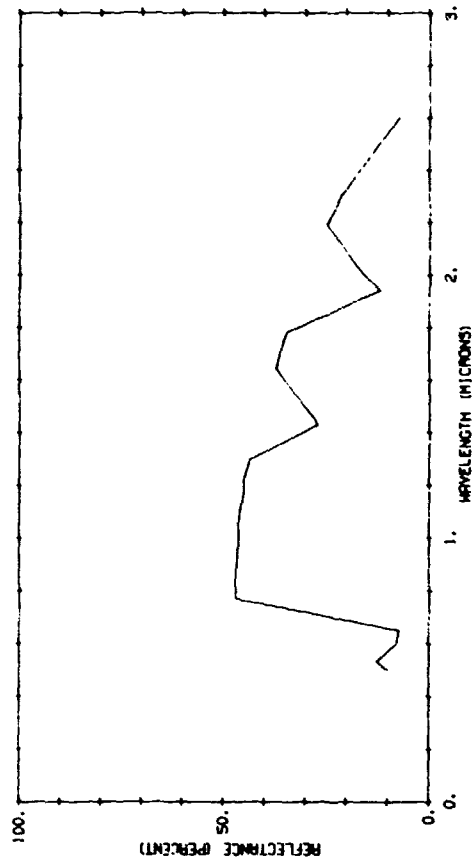
809007 153

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



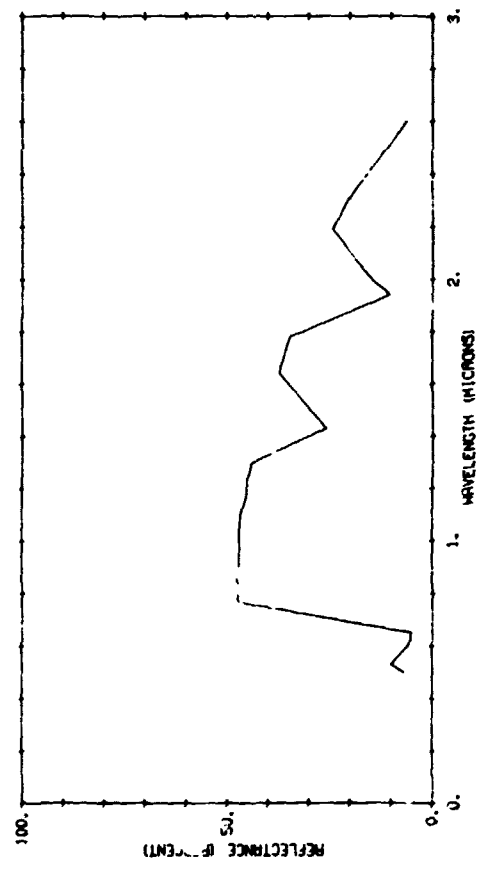
809007 154

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



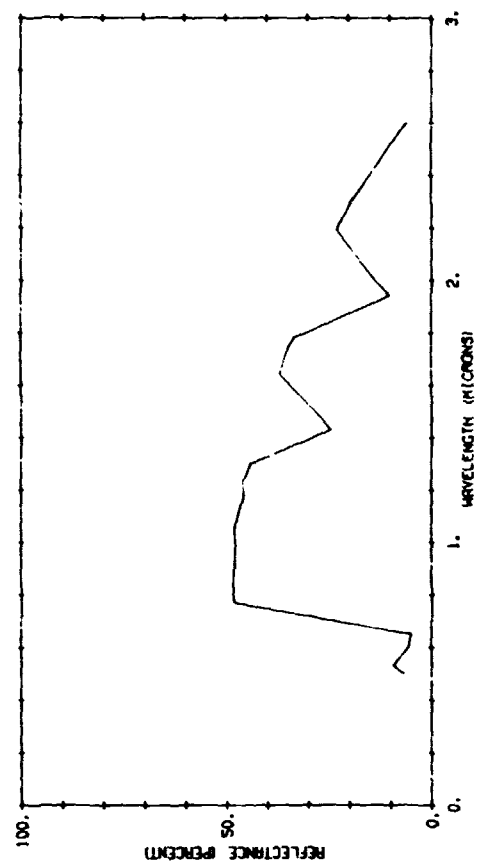
809007 155

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



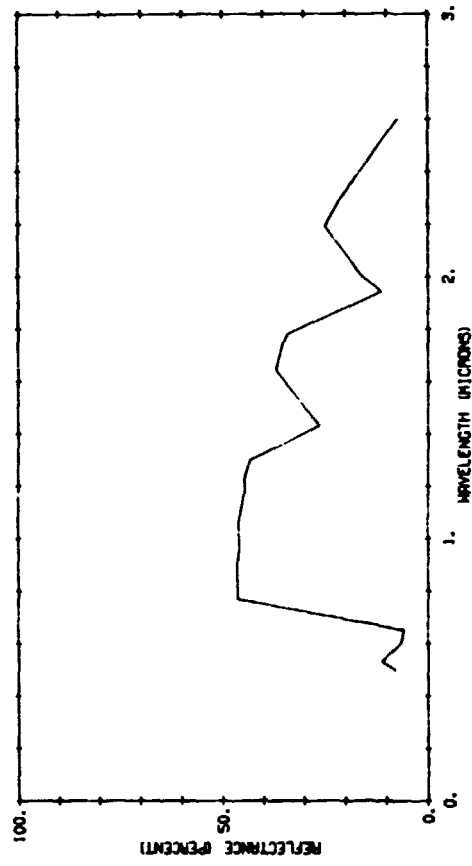
809007 156

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



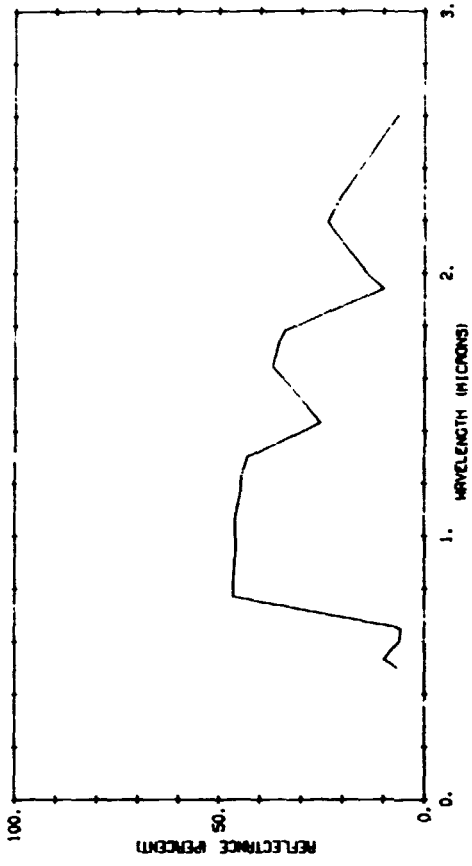
809007 157

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



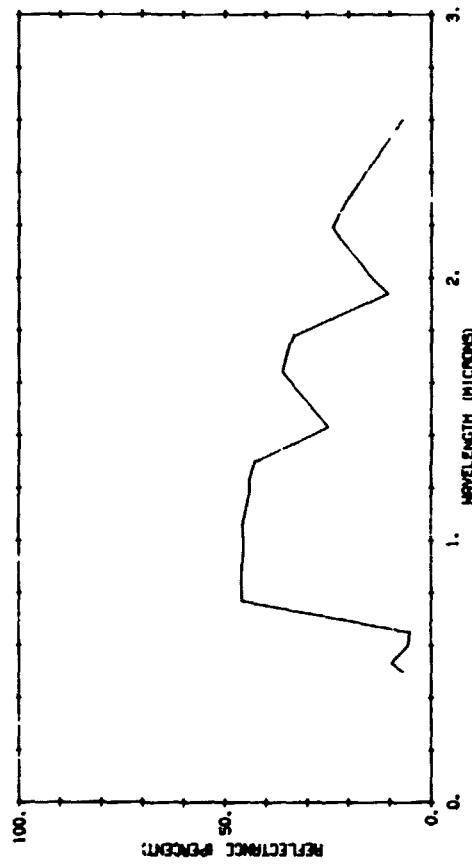
809007 158

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



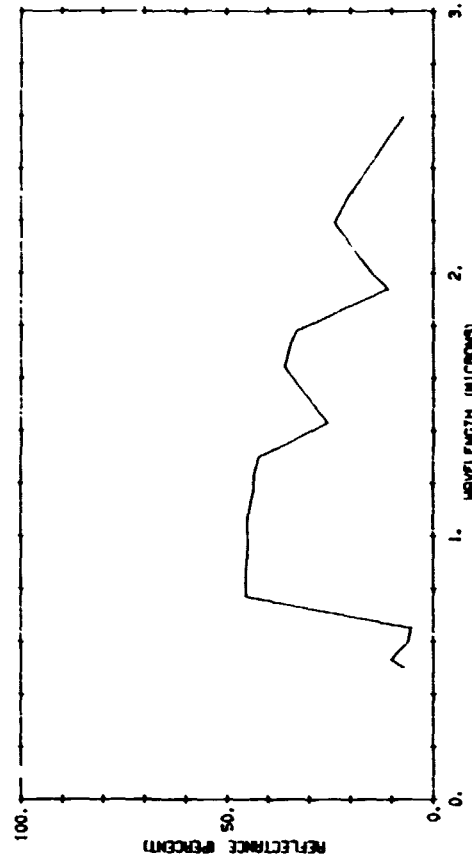
809007 159

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



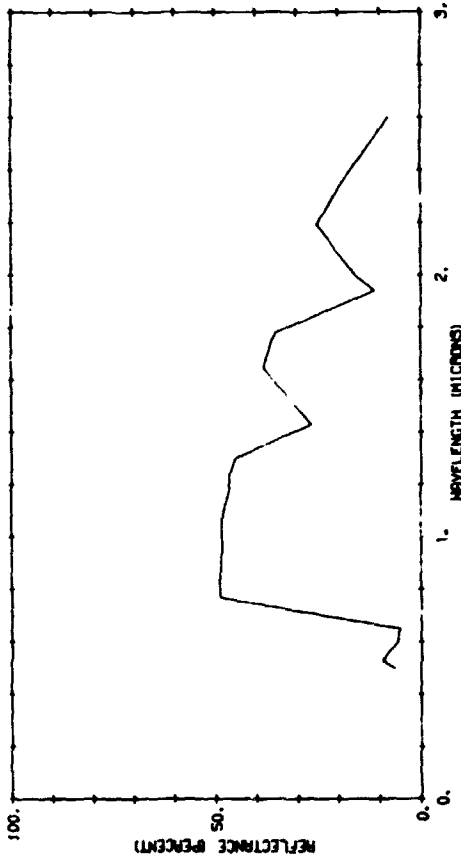
809007 160

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



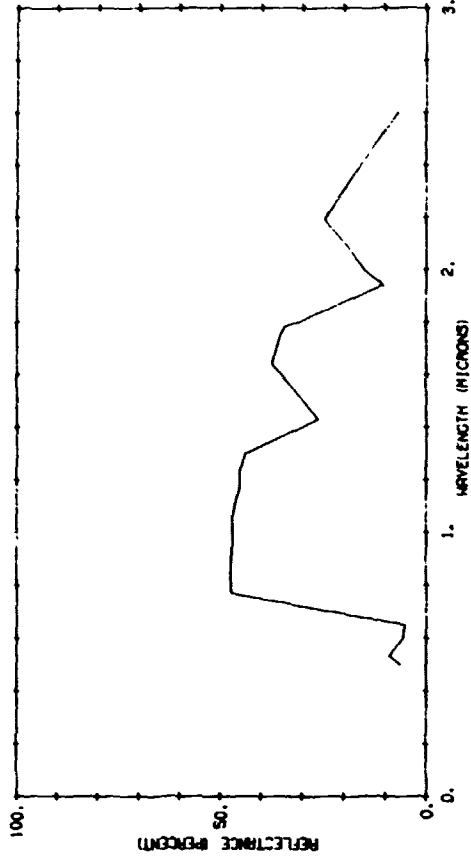
B09007 161

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



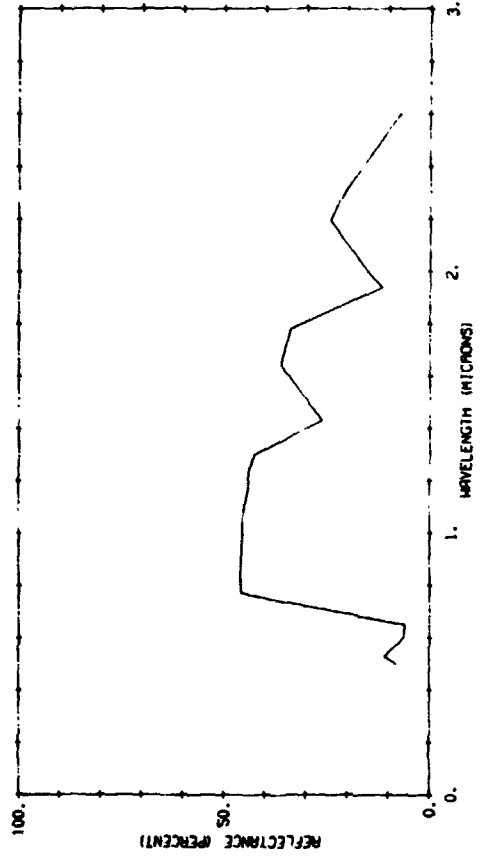
B09007 162

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



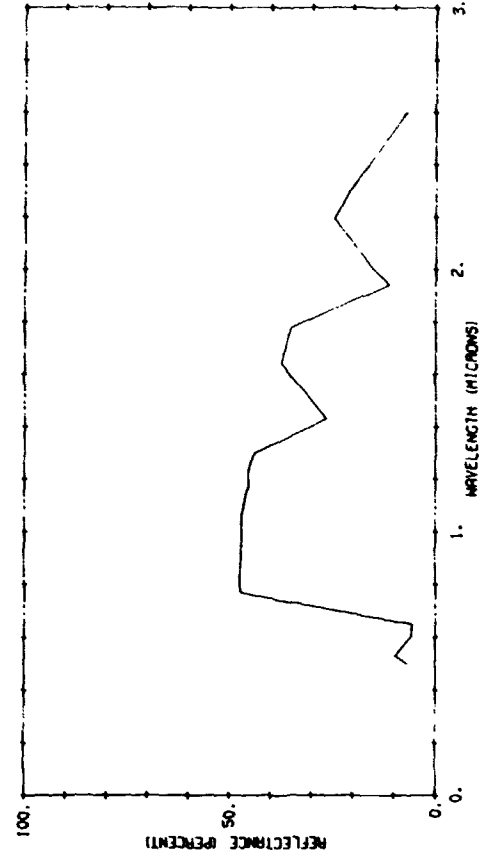
B09007 163

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



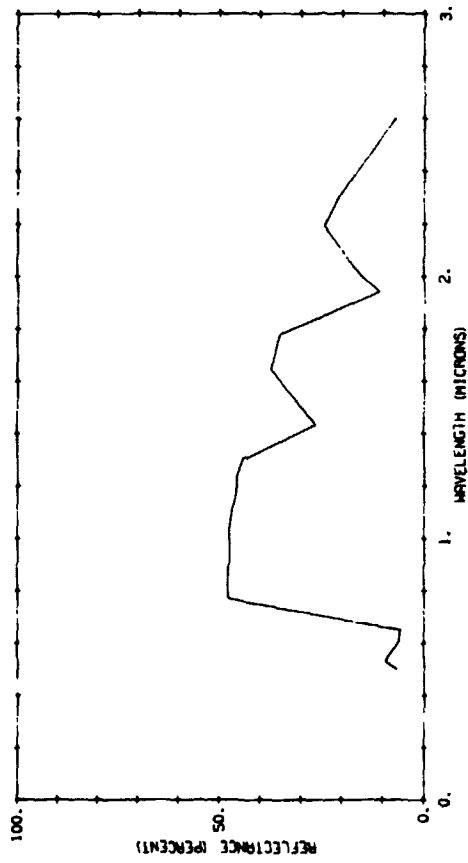
B09007 164

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



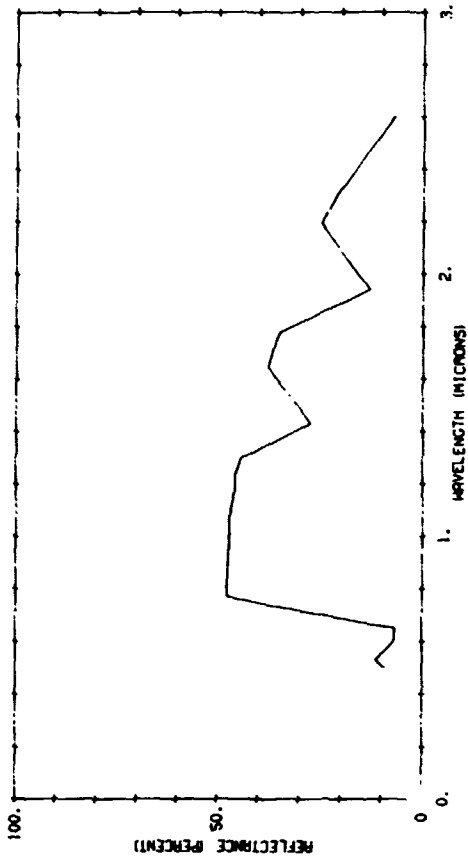
809007 165

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



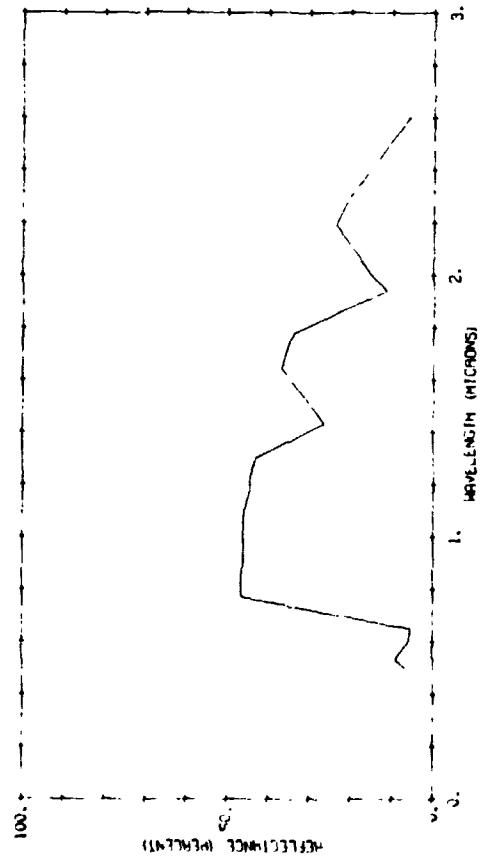
809007 166

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



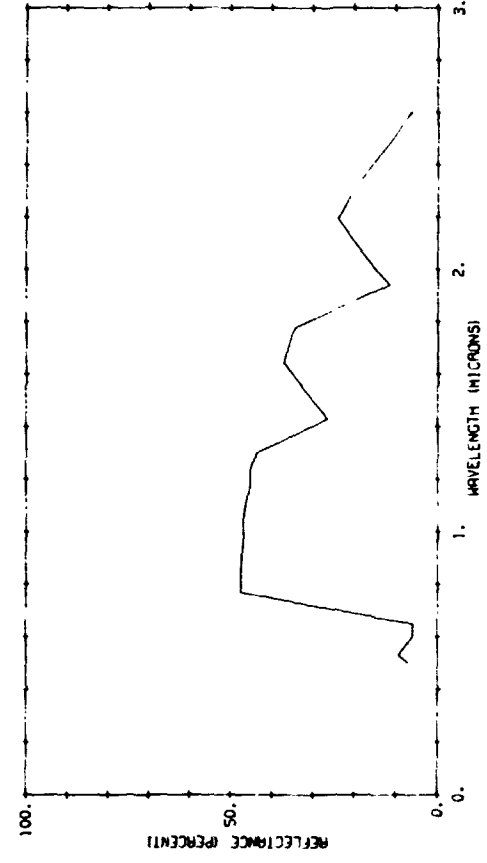
809007 167

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



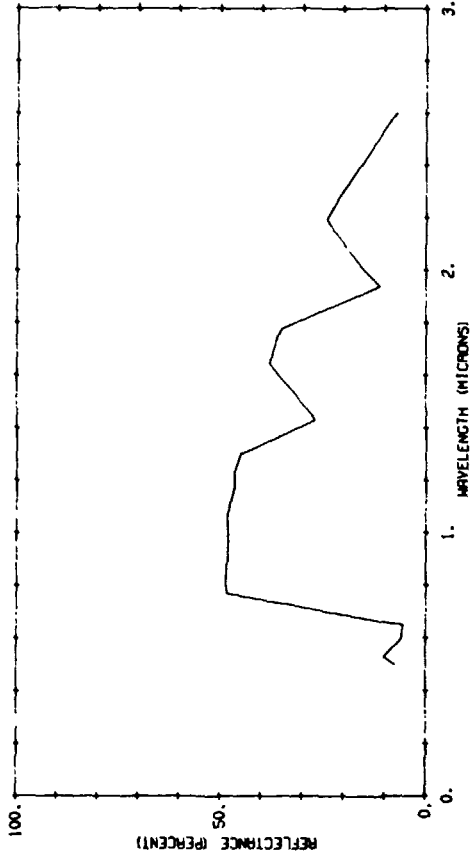
809007 168

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



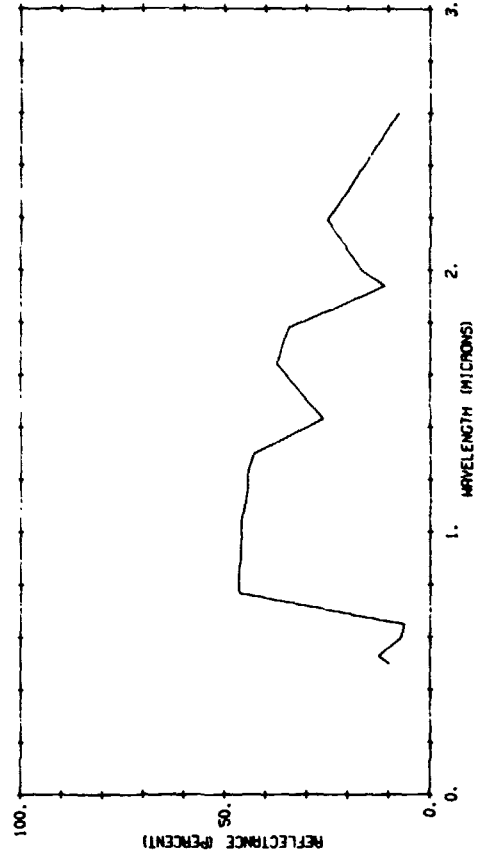
803007 170

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



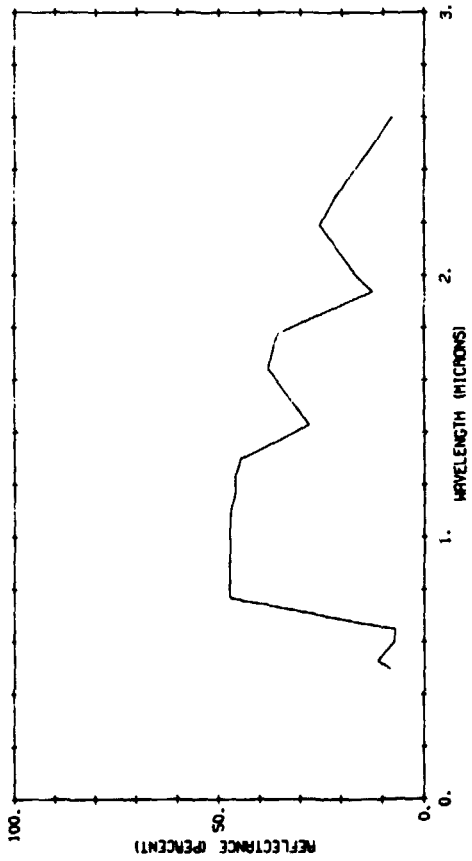
809007 172

TREE 4, LEAF 1. NO WATER SINCE 18 JUNE



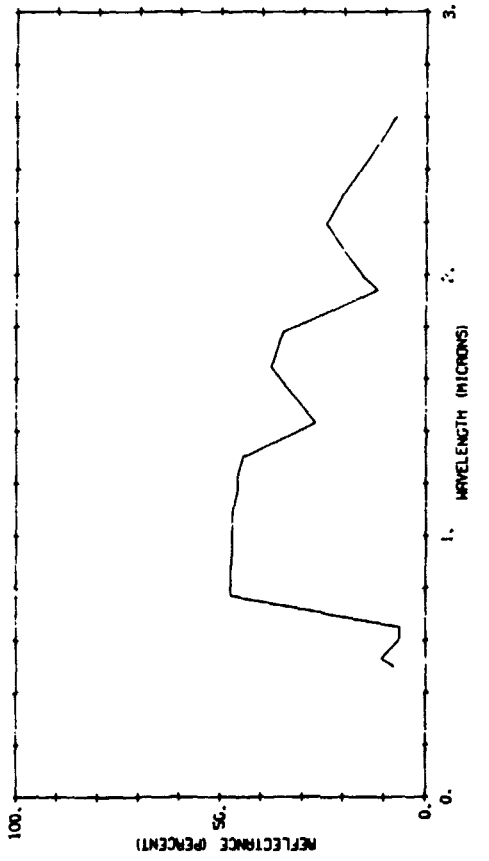
809007 169

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



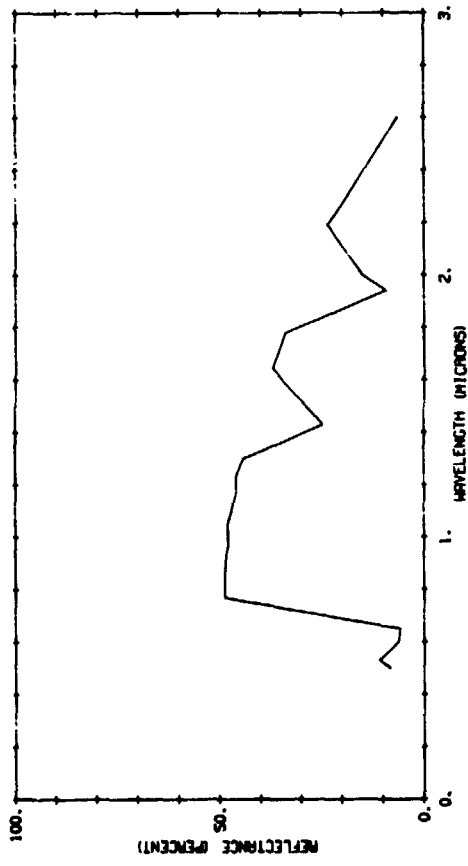
809007 171

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



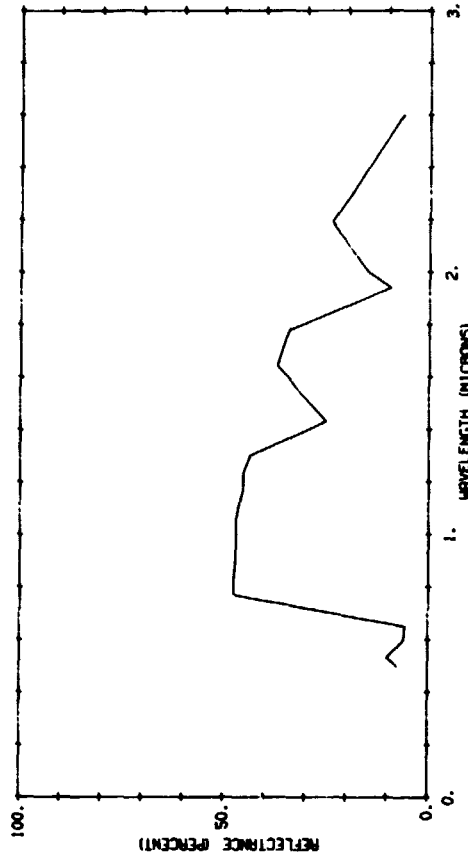
B09007 173

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



B09007 174

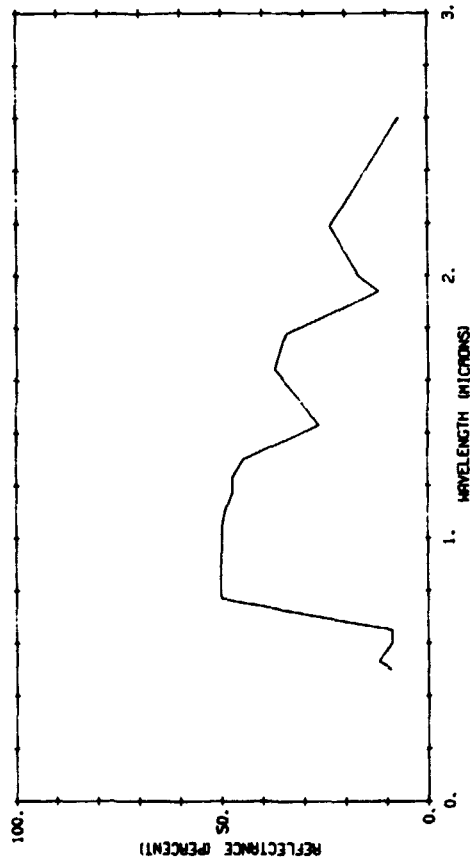
TREE 4, LEAF 3. NO WATER SINCE 18 JUNE.



61 K4 - 44

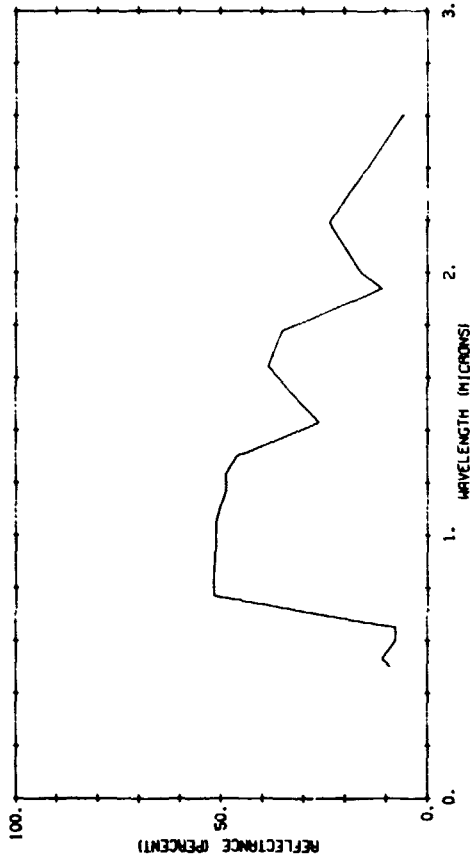
B09007 175

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



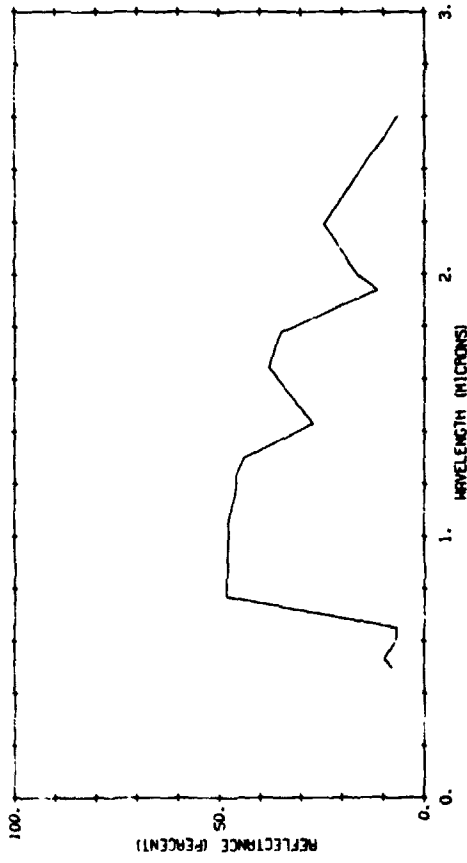
B09007 176

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



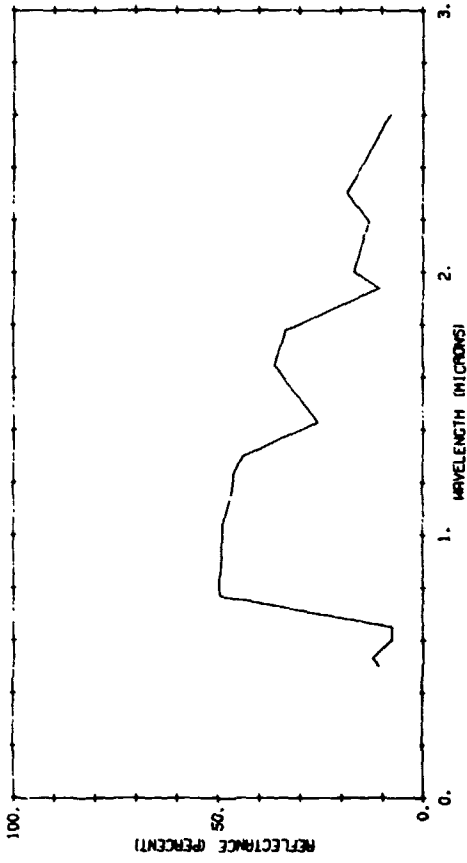
B09007 177

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



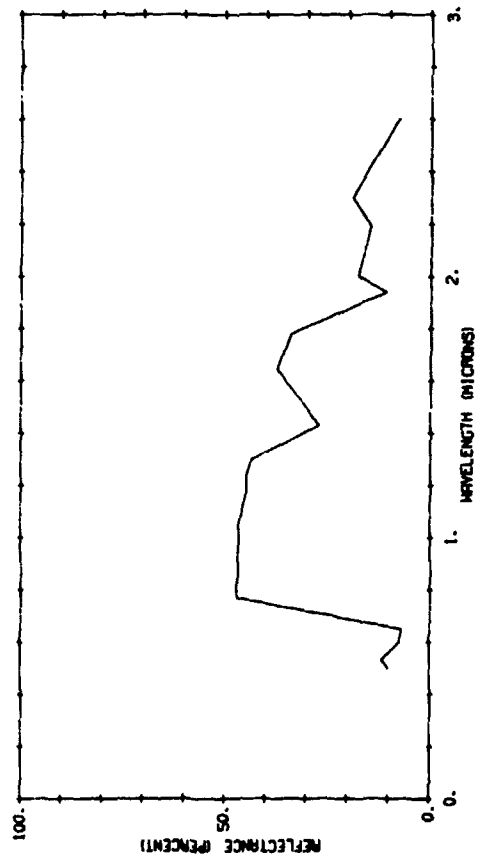
B09007 178

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



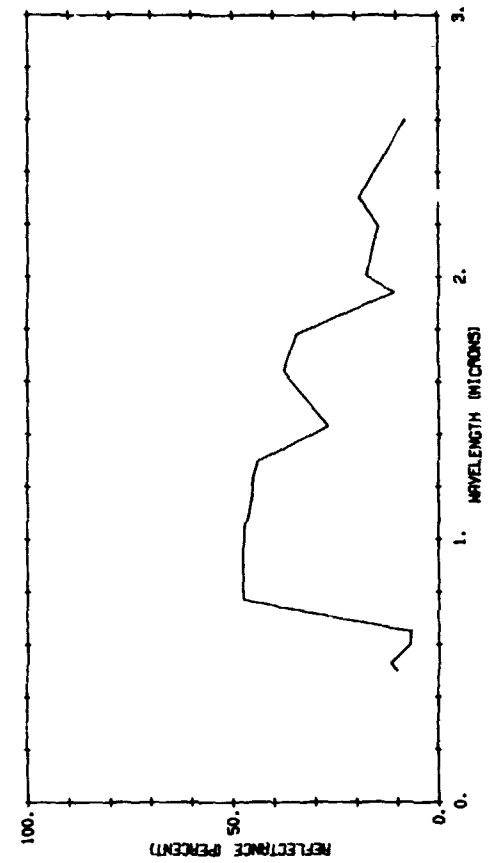
B09007 179

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



B09007 180

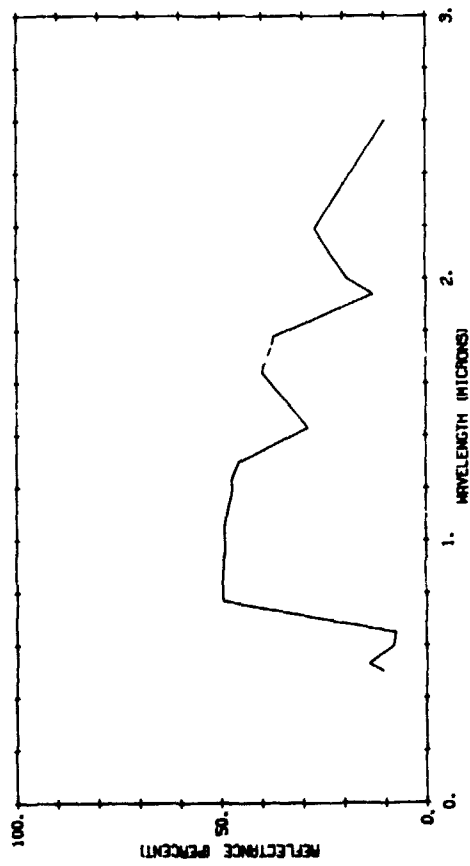
TREE 4, LEAF 3. NO WATER SINCE 18 JUNE.



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

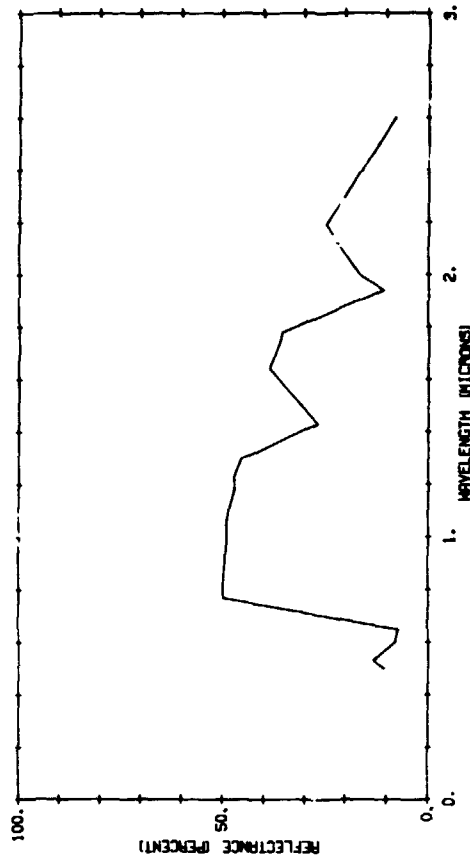
B09007 181

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



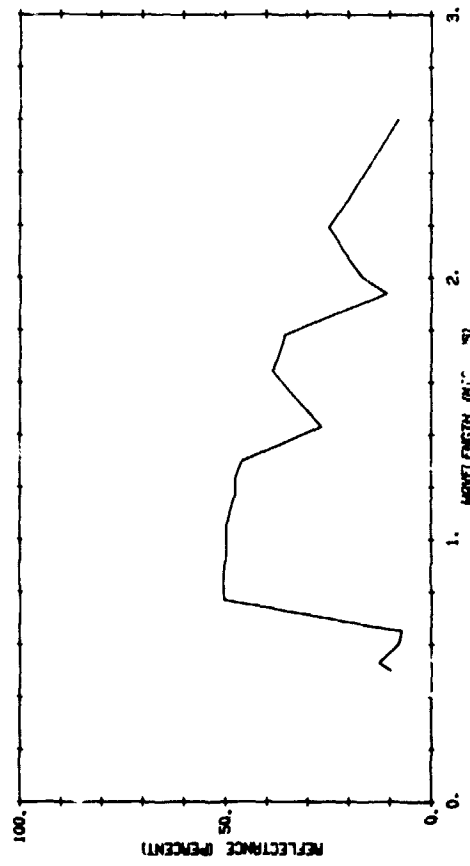
B09007 182

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



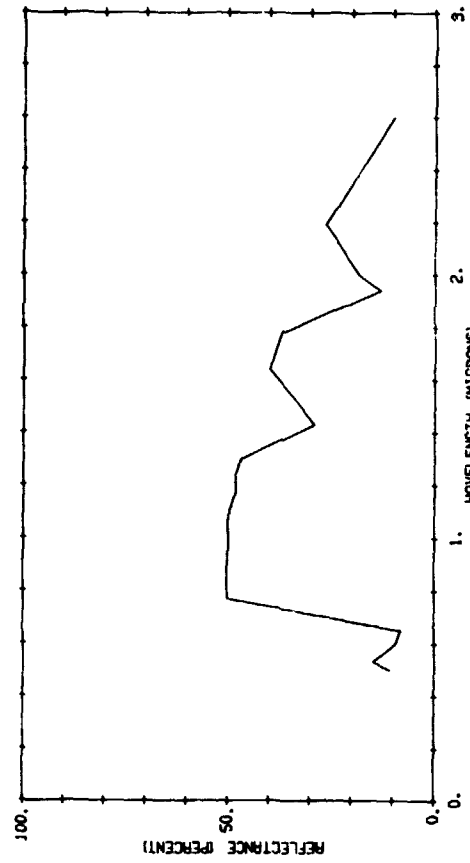
61 K4 - 46

B09007 183
TREE 4, LEAF 1. NO WATER SINCE 18 JUNE.



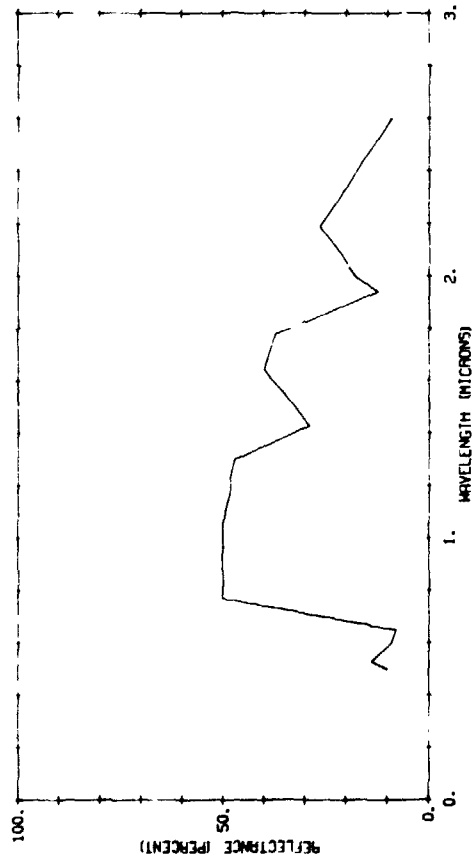
B09007 184

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



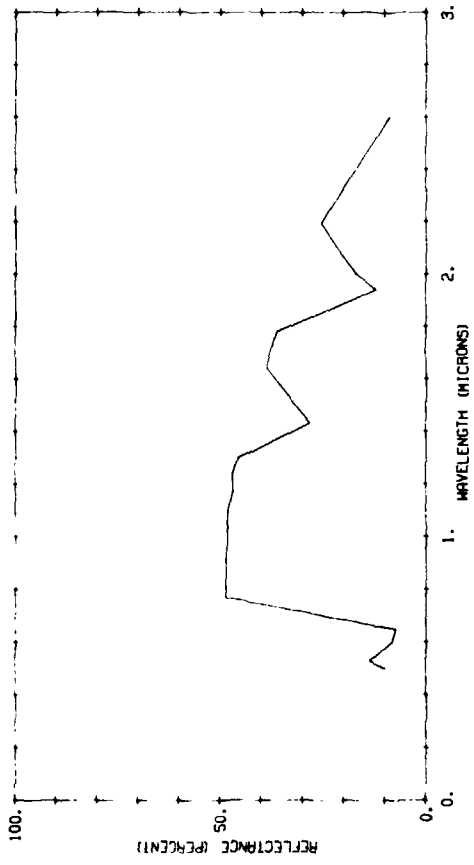
B09007 185

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



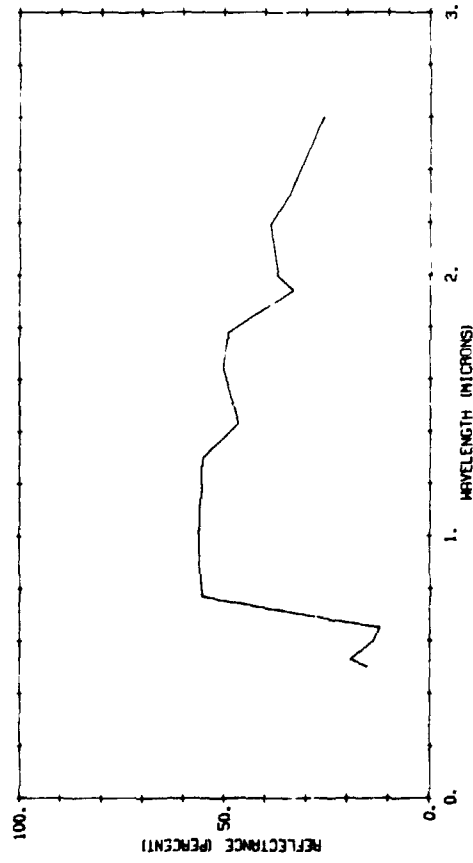
B09007 186

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



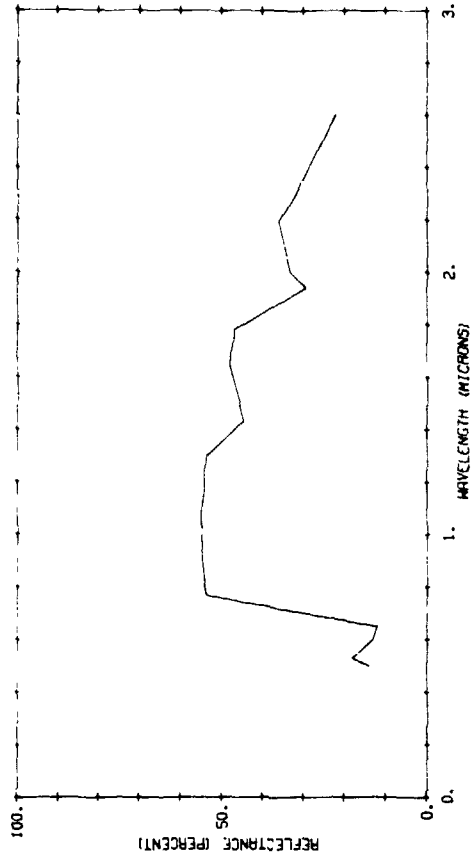
B09007 187

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



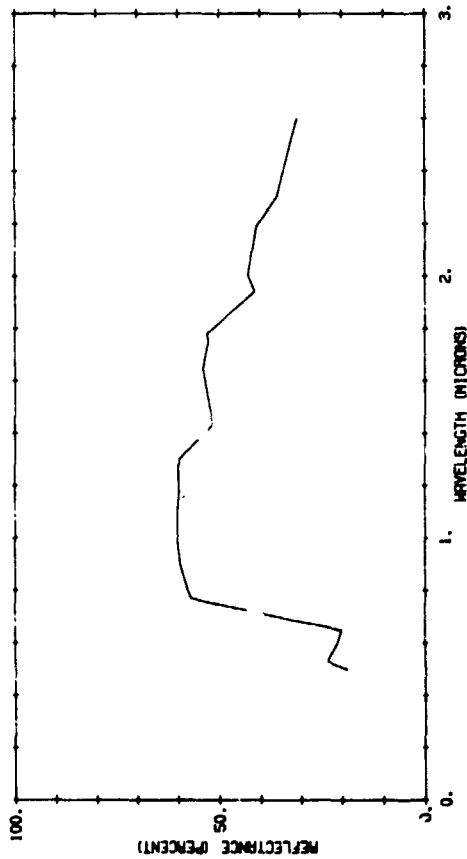
B09007 188

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



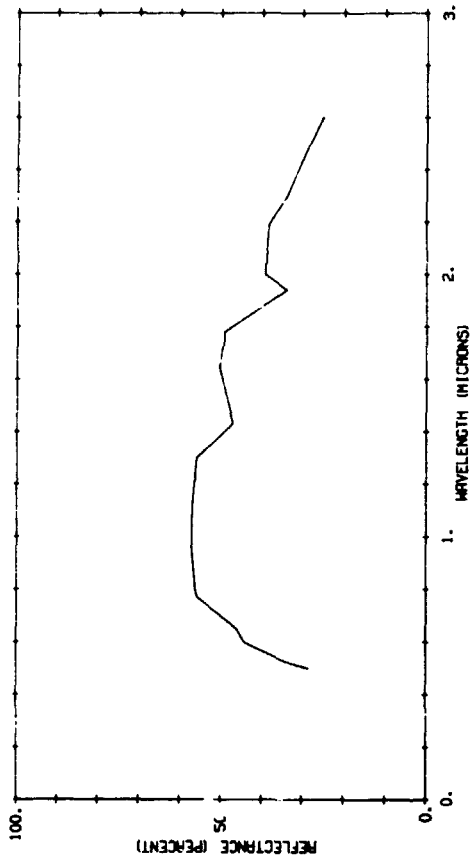
B09007 189

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



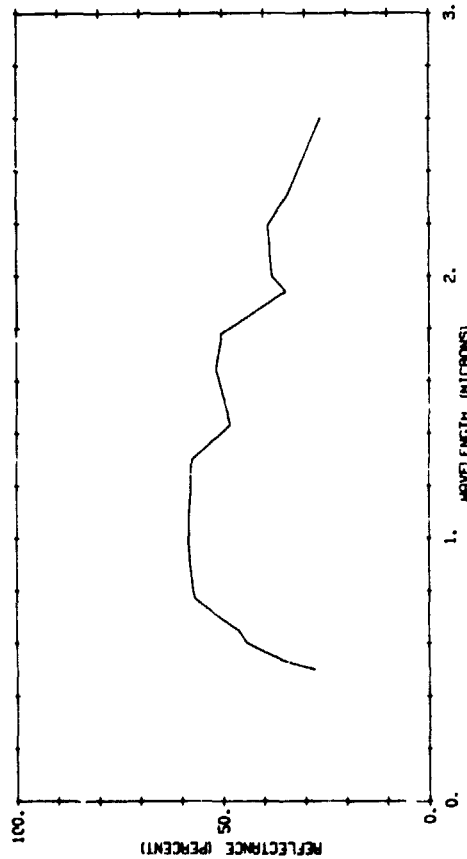
B09007 190

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



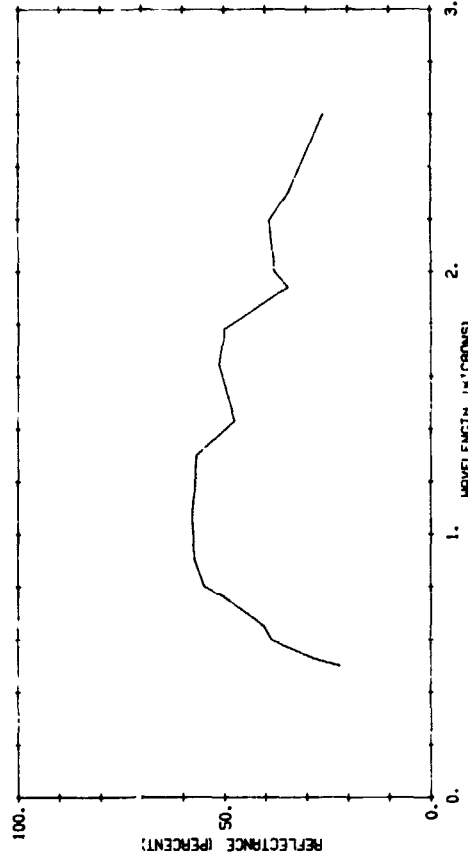
B09007 191

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



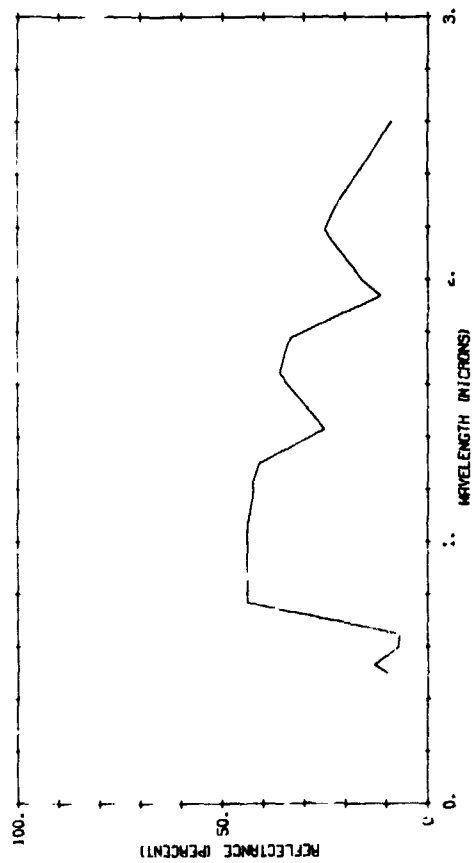
B09007 192

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



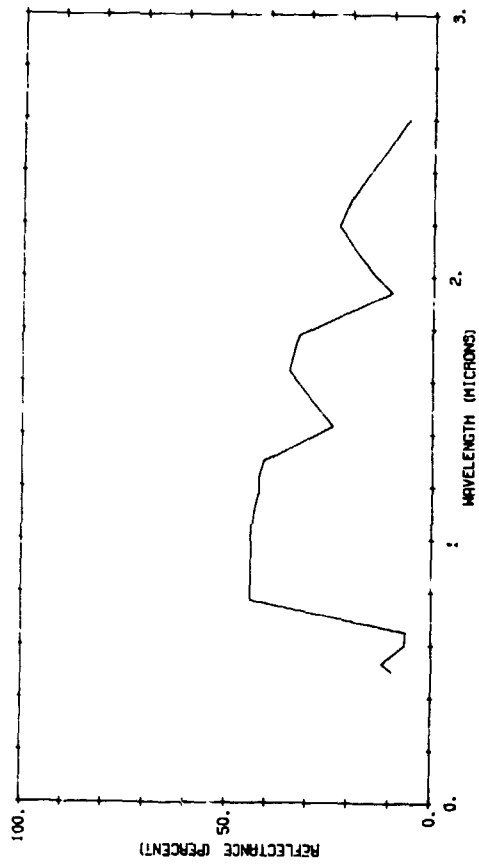
B09007 193

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



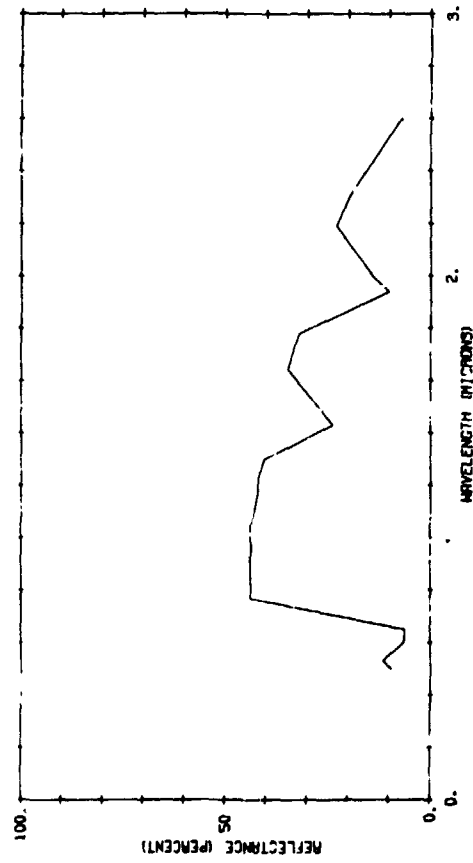
B09007 194

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



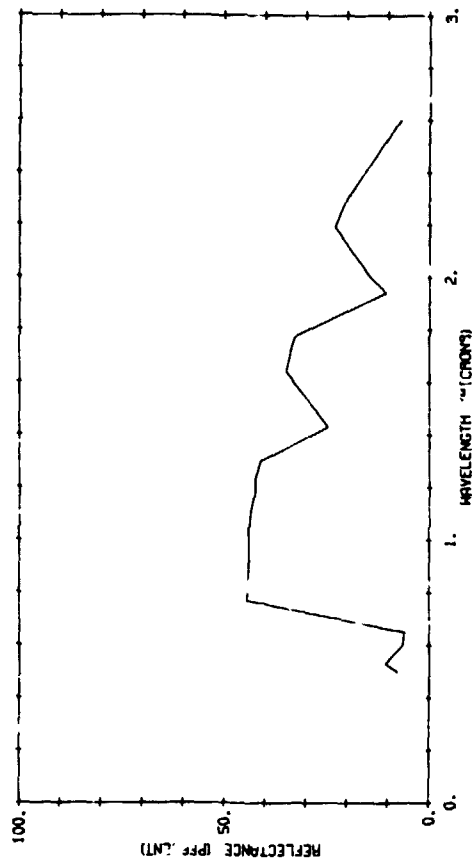
B09007 195

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



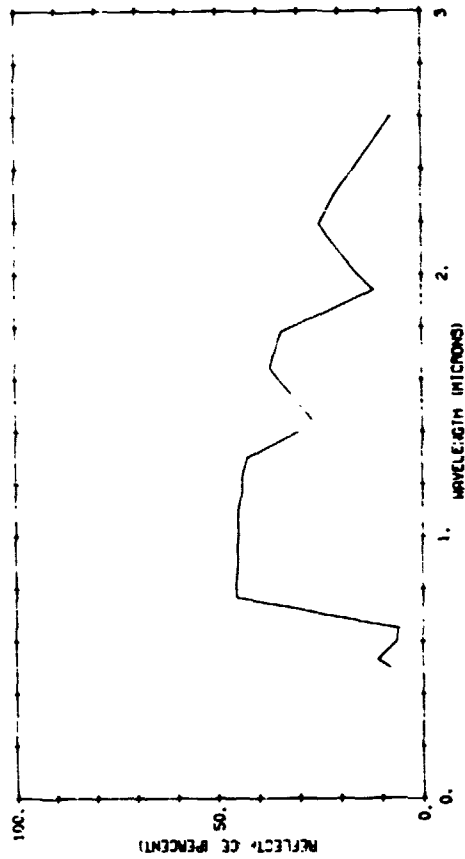
B09007 196

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



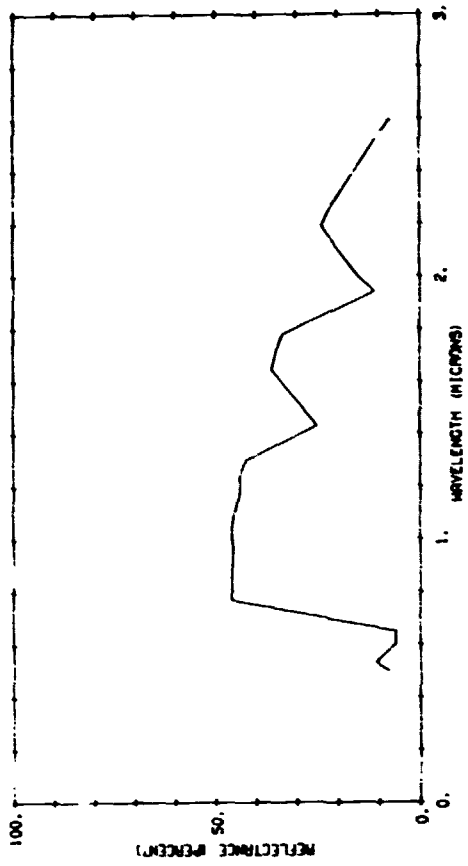
B09007 197

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



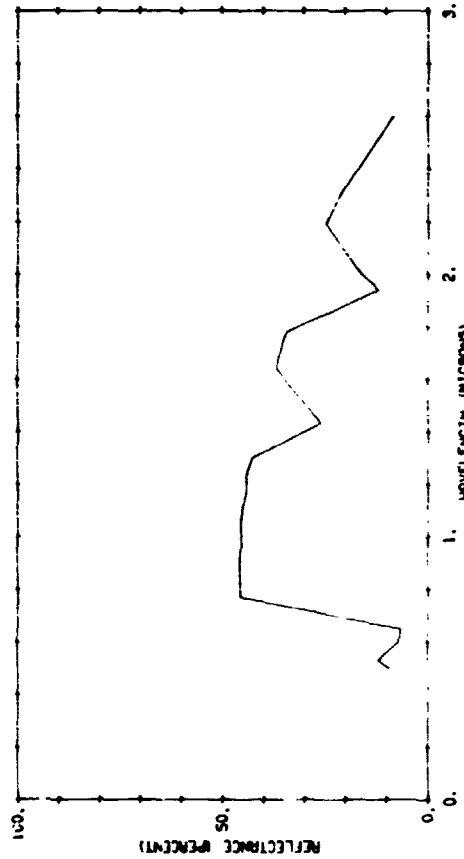
B09007 198

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



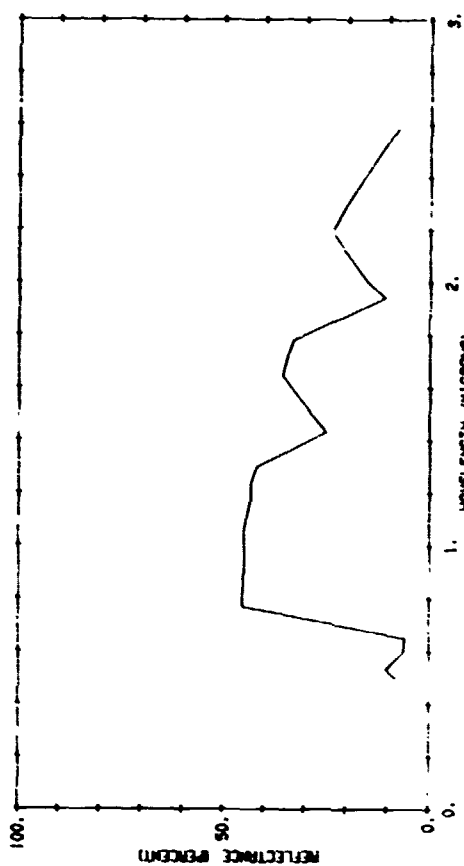
B09007 199

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



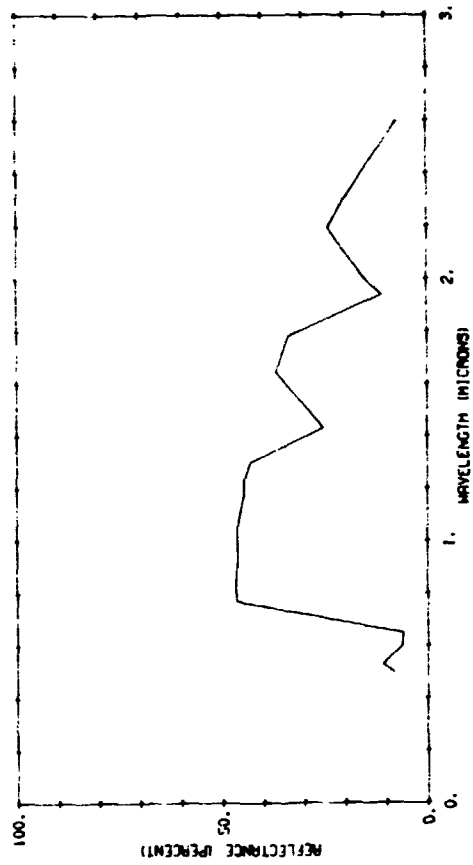
B09007 200

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



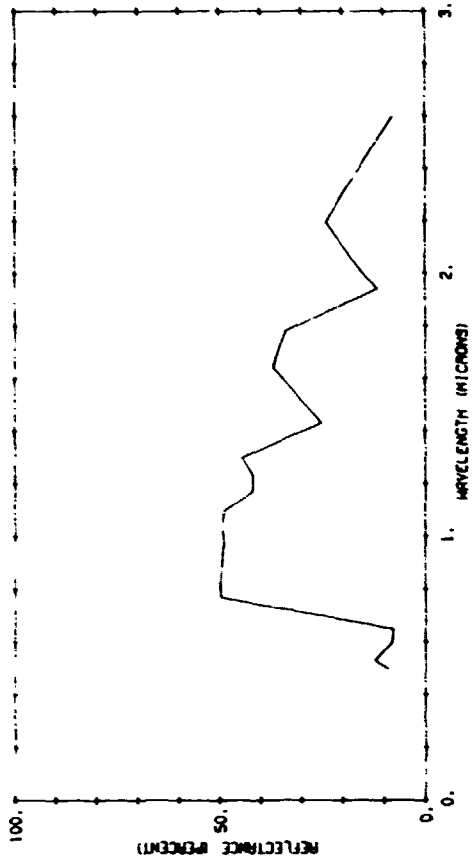
809007 201

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



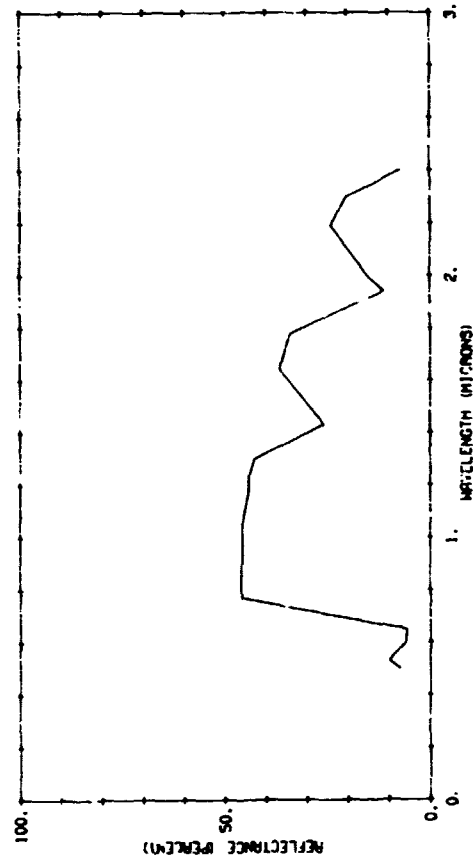
809007 202

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



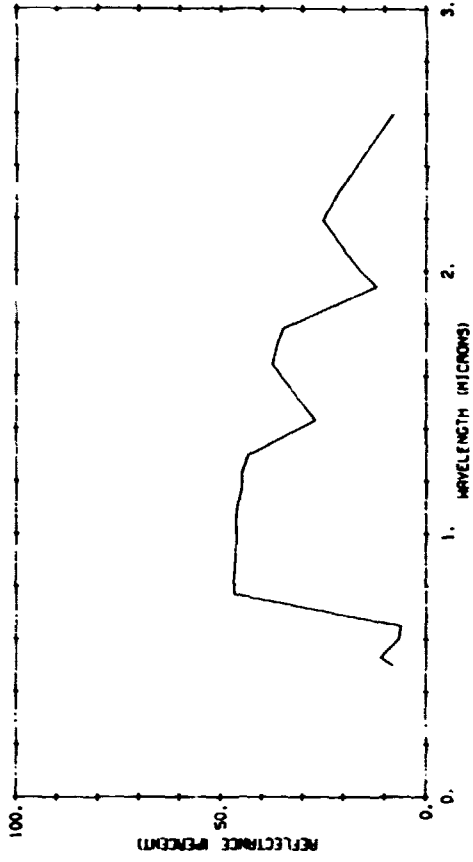
809007 203

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



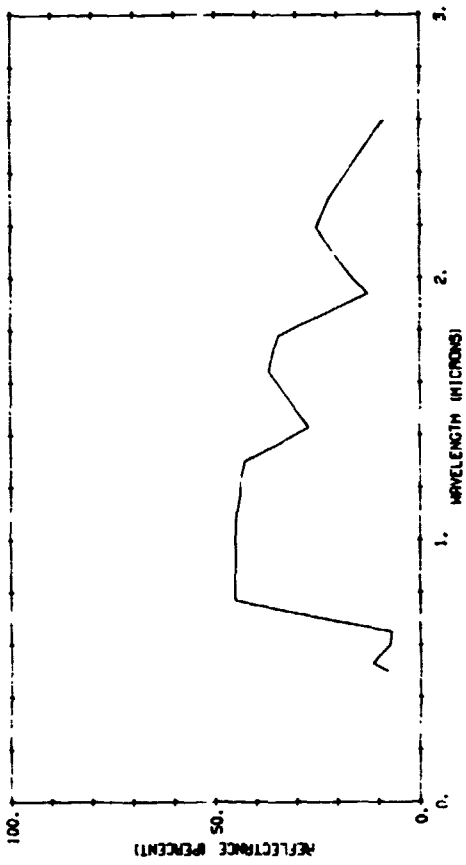
809007 204

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



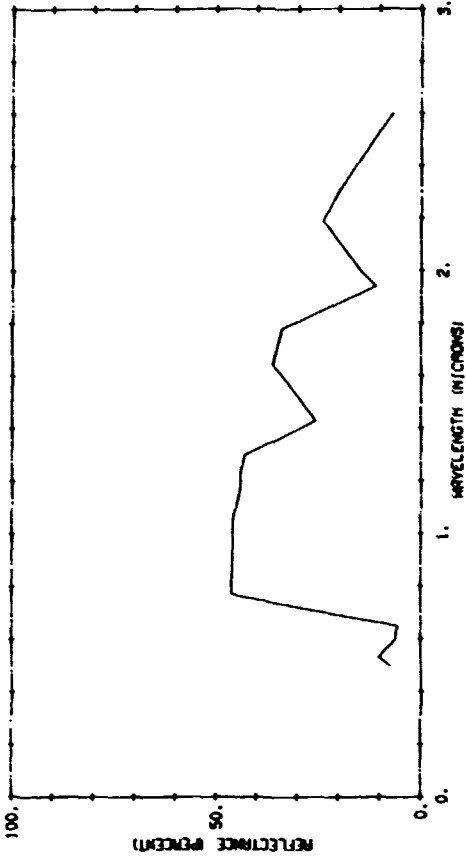
809007 205

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



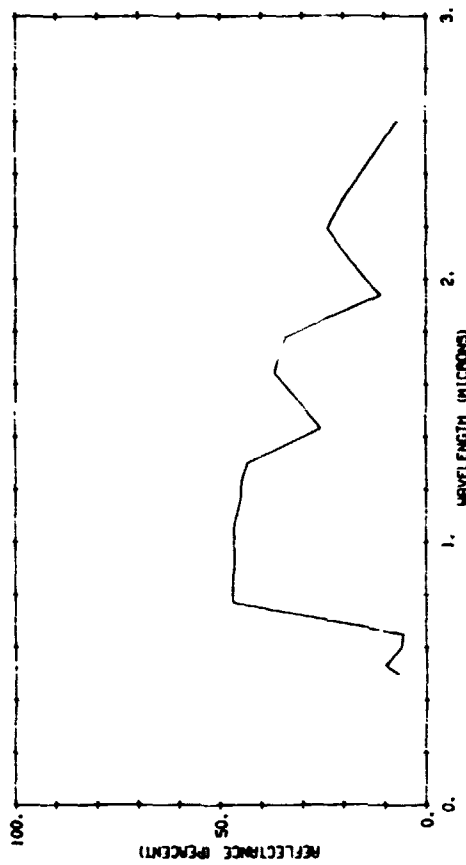
809007 206

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



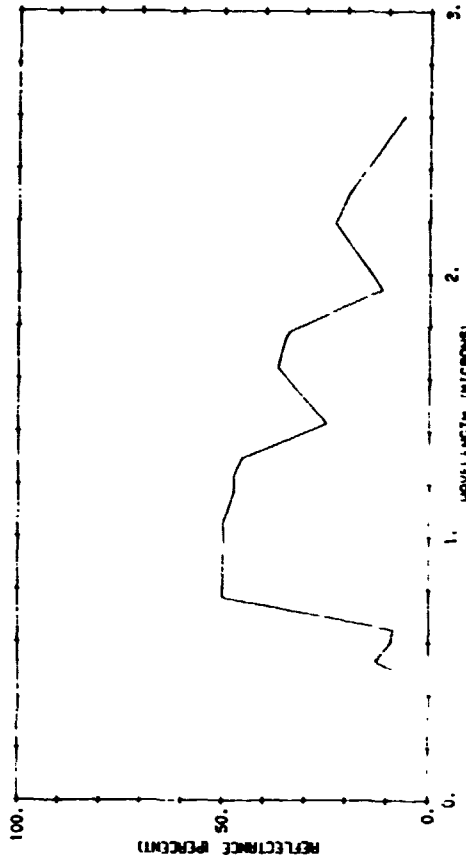
809007 207

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



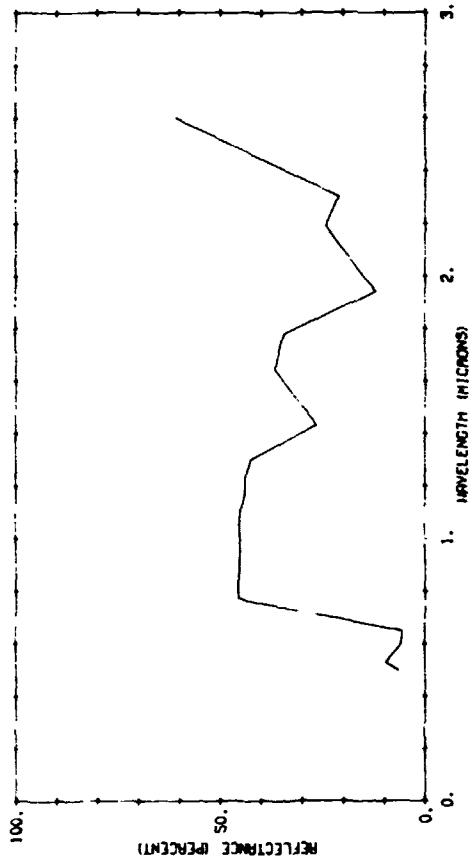
809007 208

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



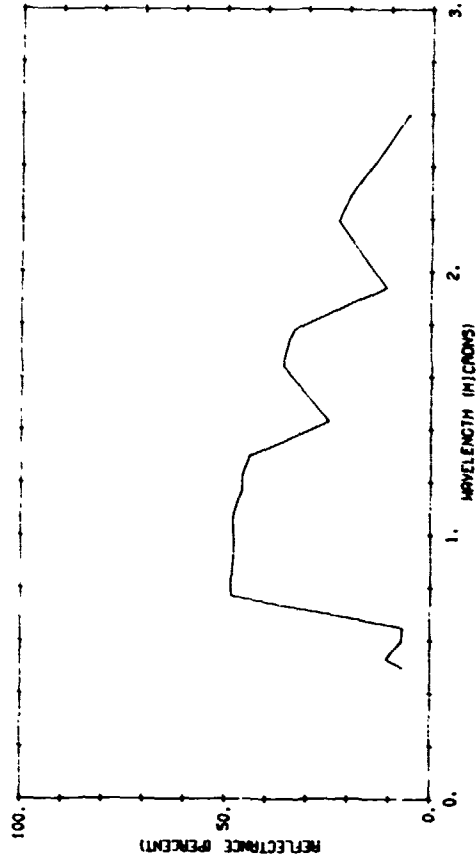
809007 209

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



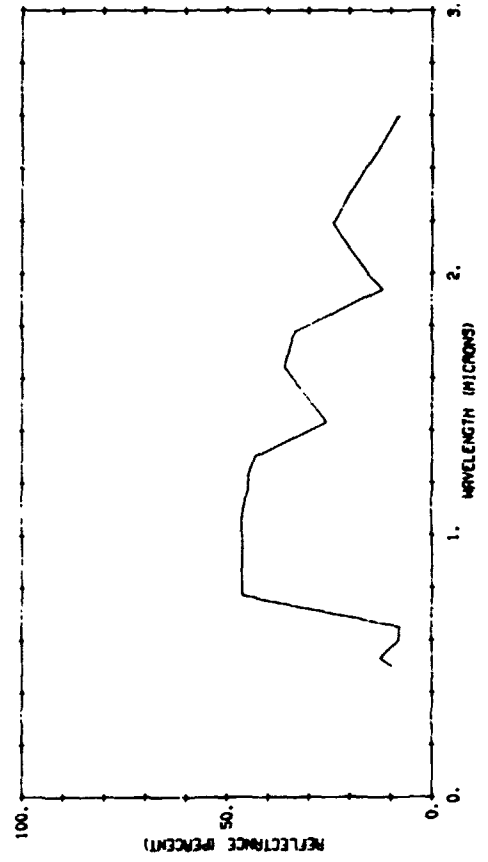
809007 210

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



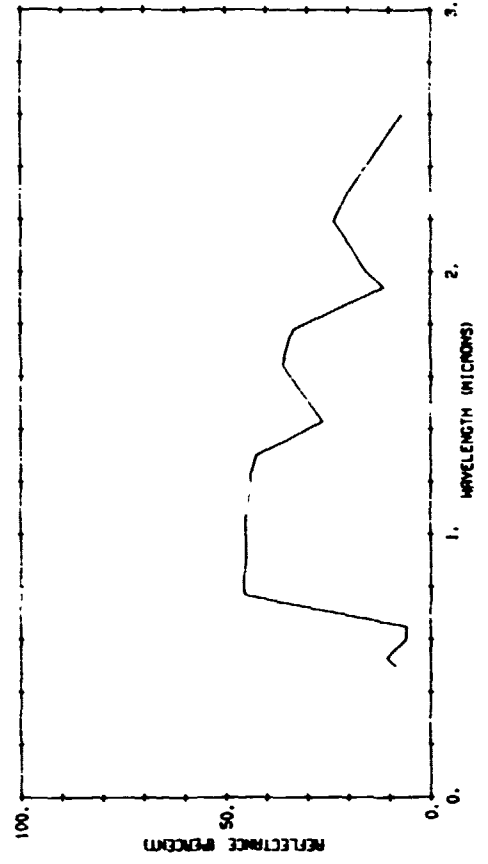
809007 211

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



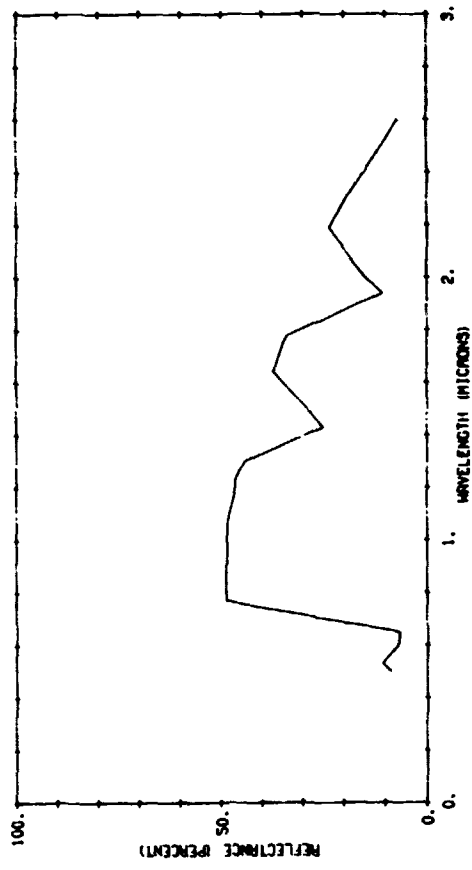
809007 212

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



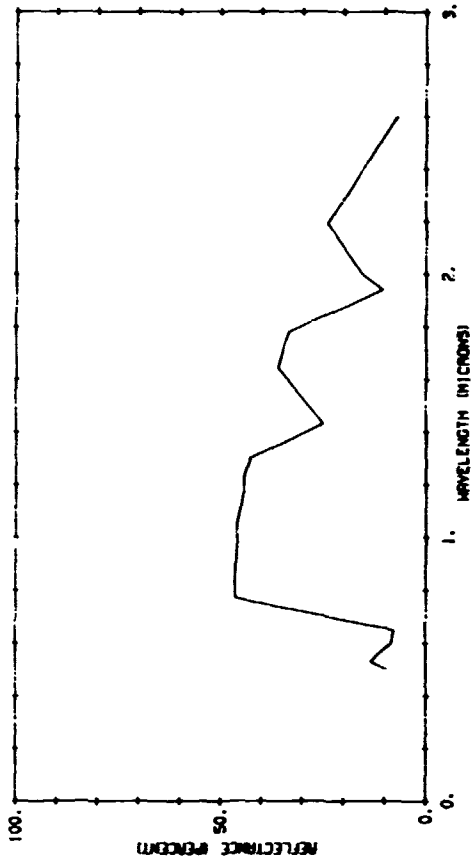
809007 213

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



809007 214

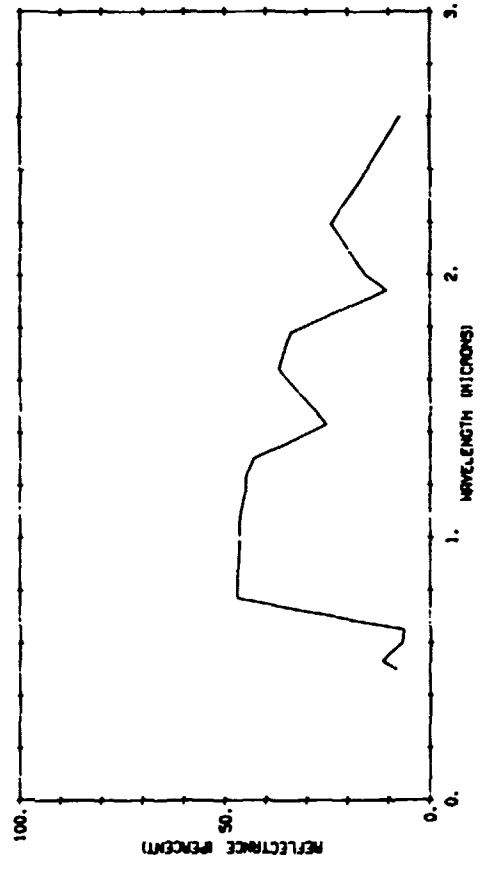
TREE 5, LEAF 1, NO WATER SINCE 18 JUNE



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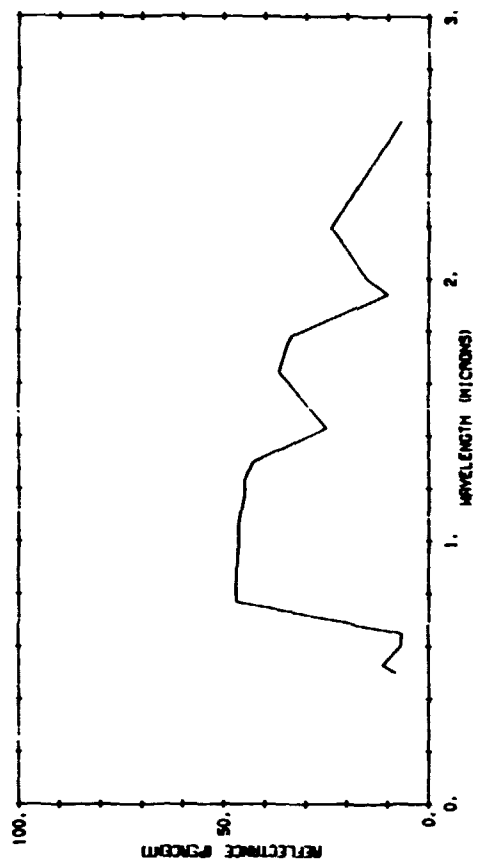
809007 215

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



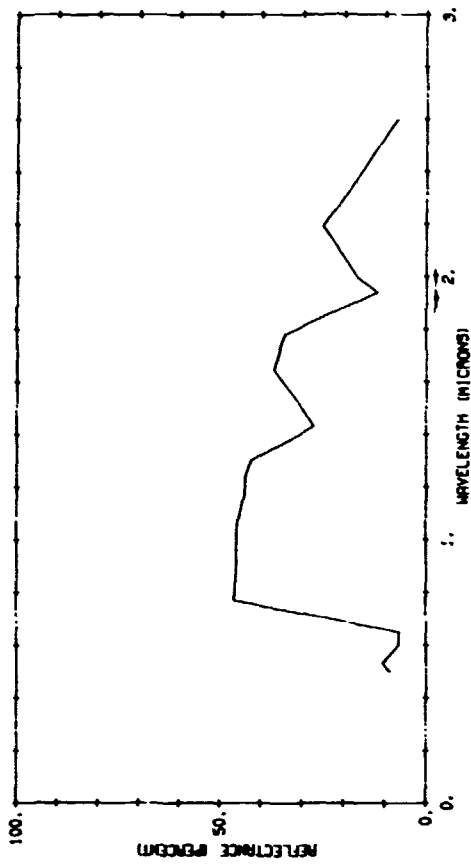
809007 216

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



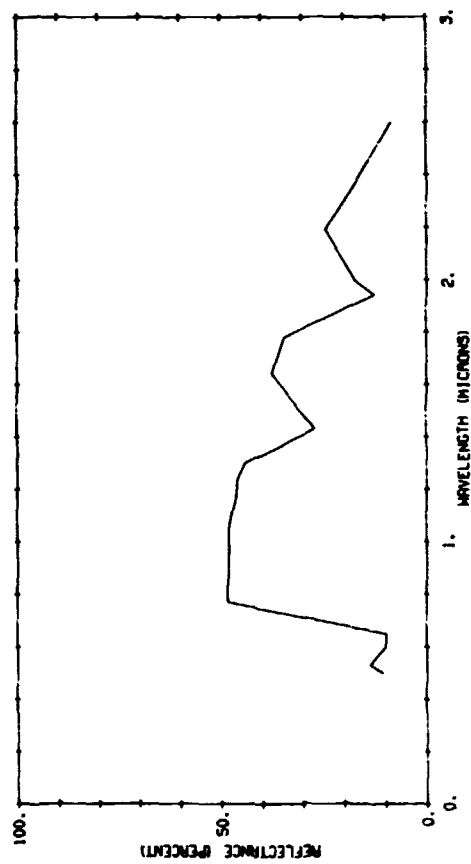
809007 218

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



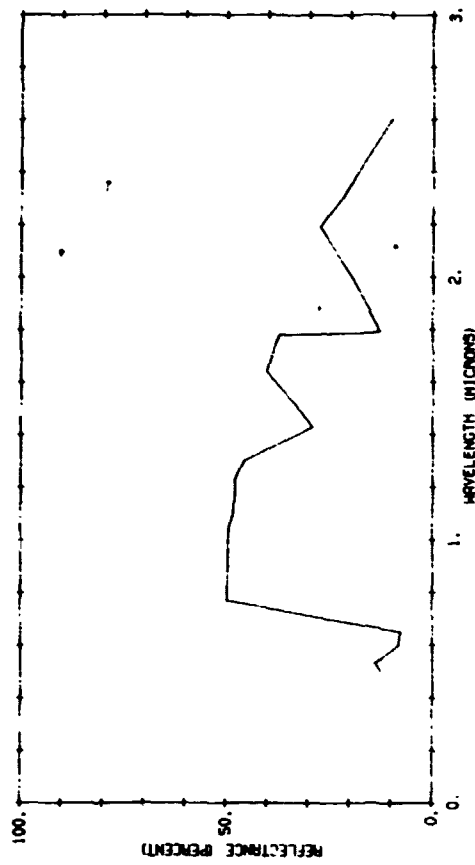
809007 217

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



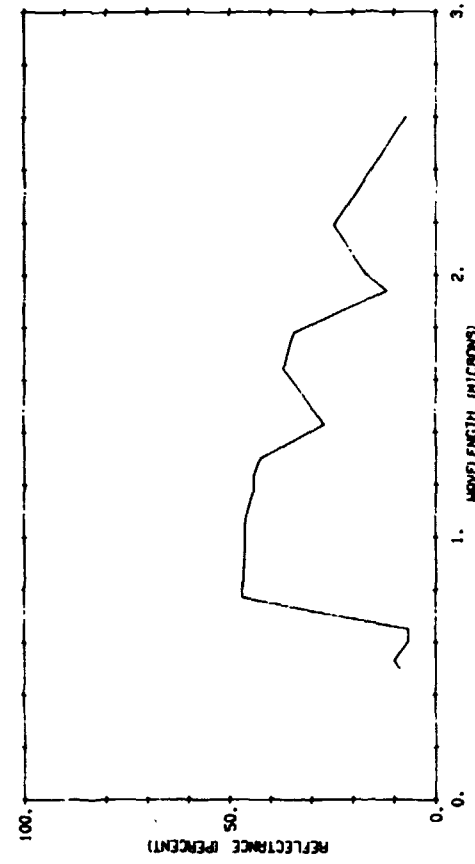
809007 220

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



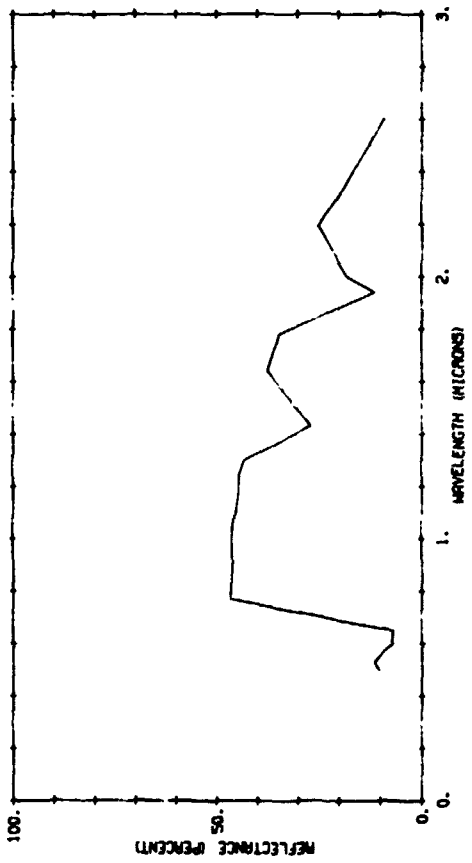
809007 219

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



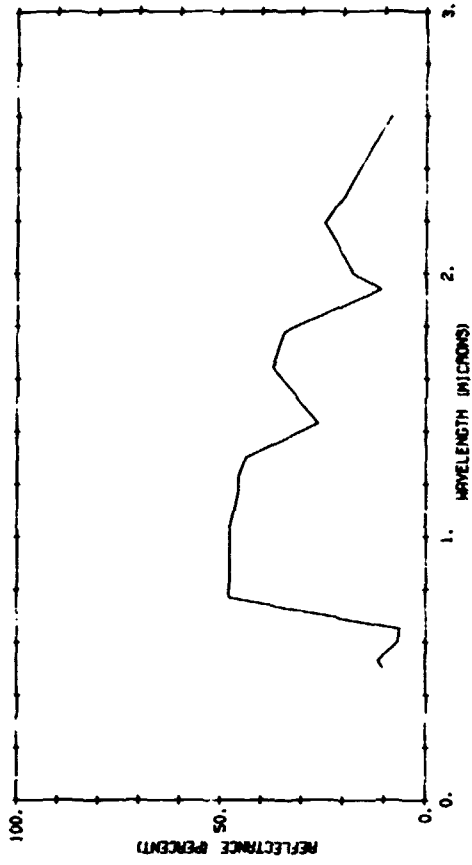
809007 221

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



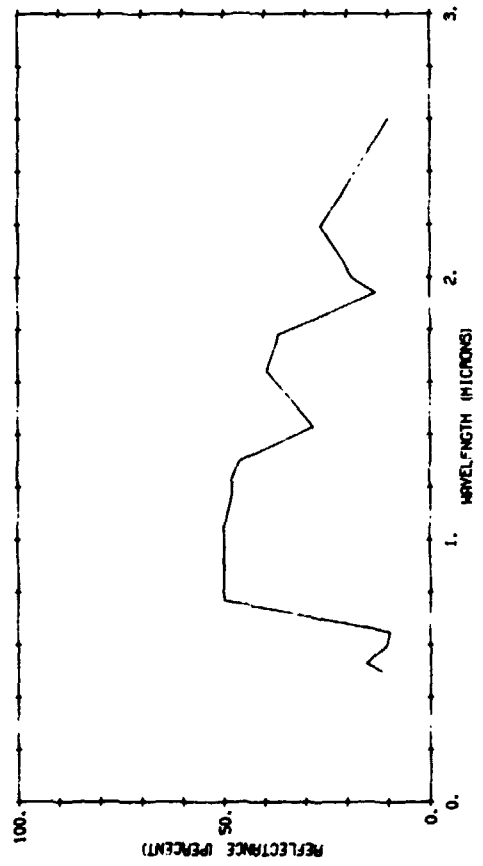
809007 222

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



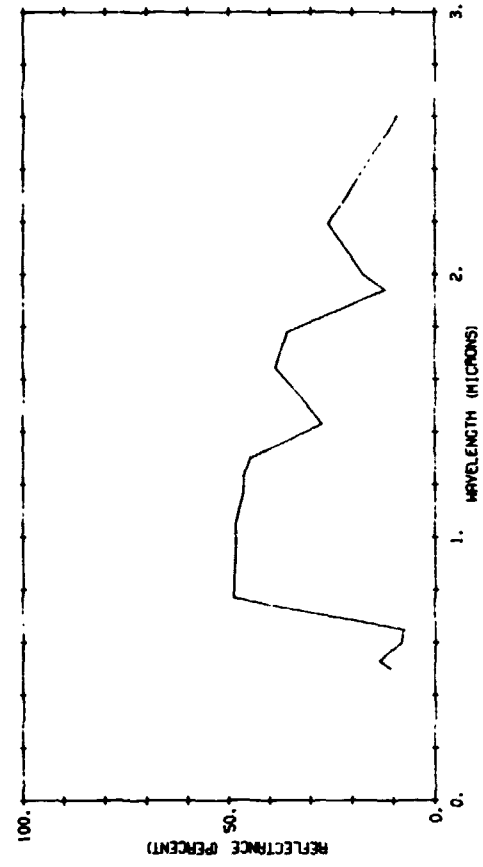
809007 223

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



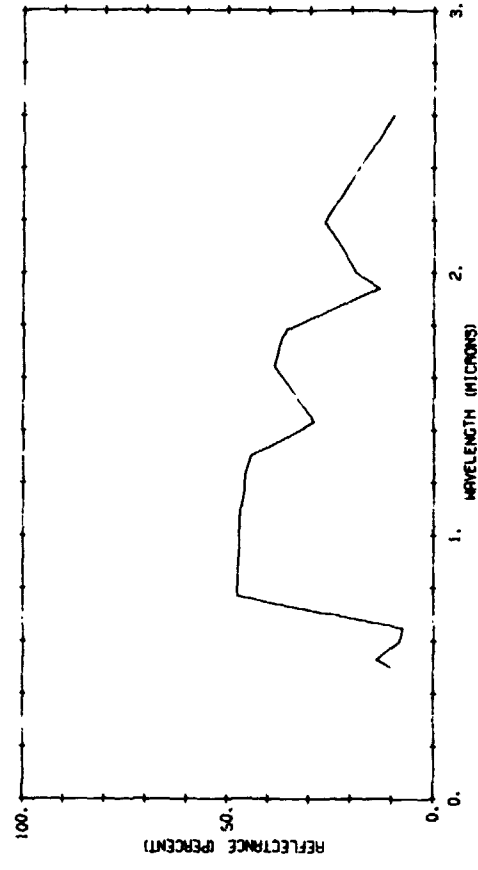
809007 224

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



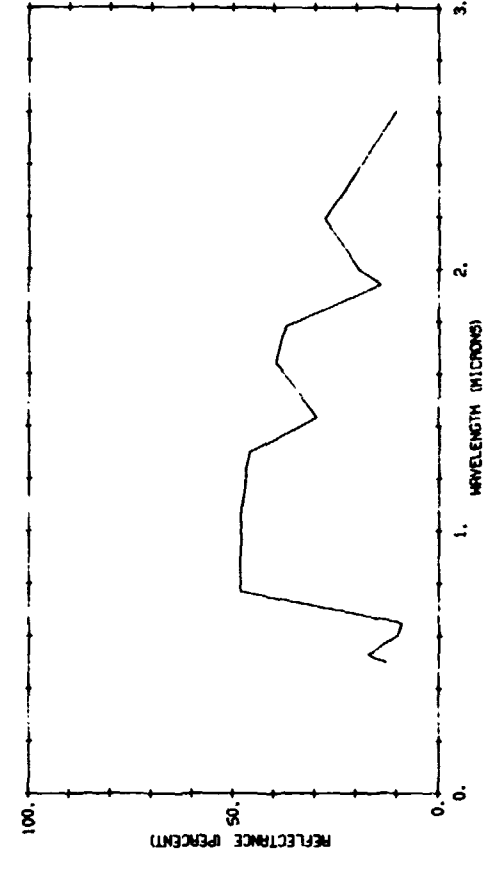
B09007 226

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



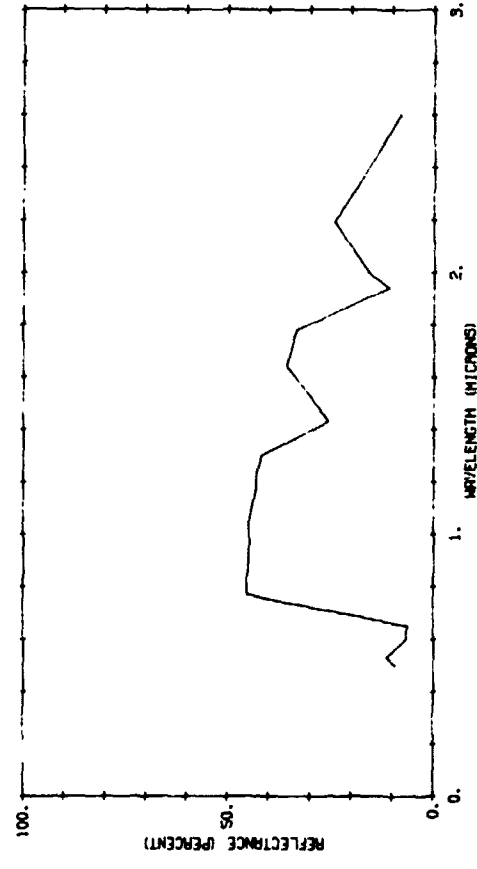
B09007 228

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



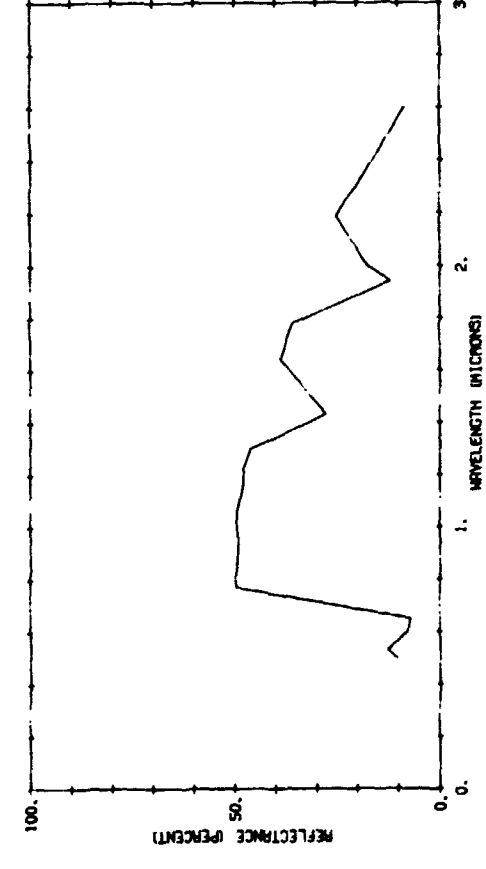
B09007 225

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



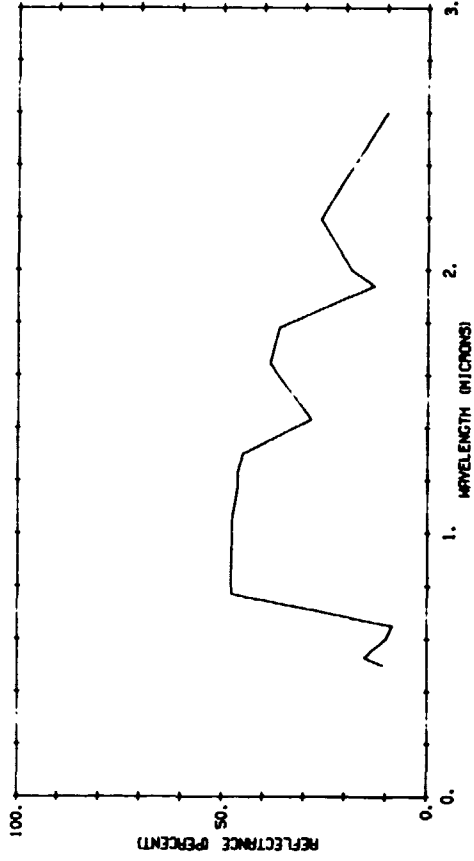
B09007 227

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



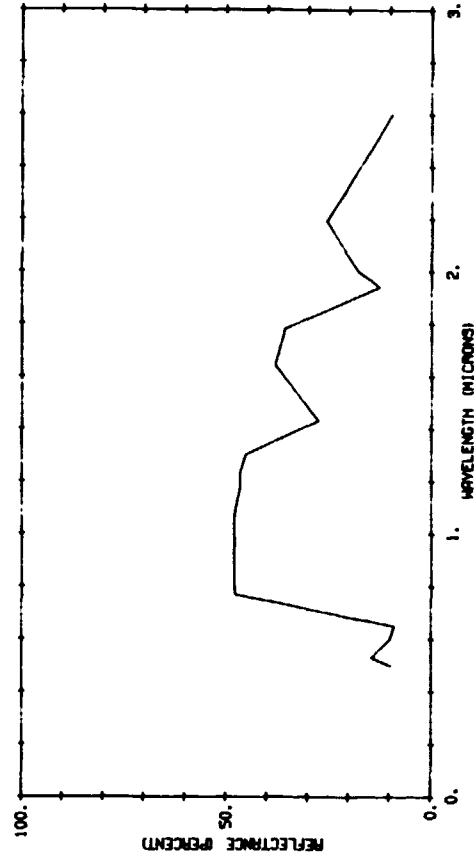
B09007 230

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



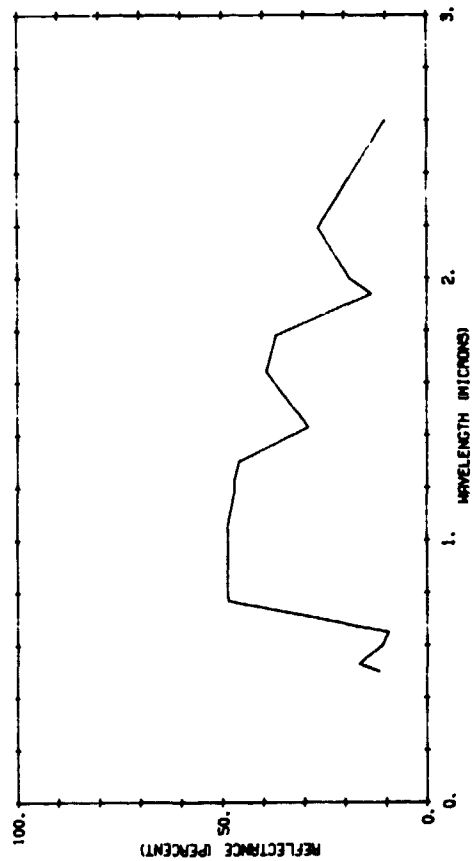
B09007 232

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



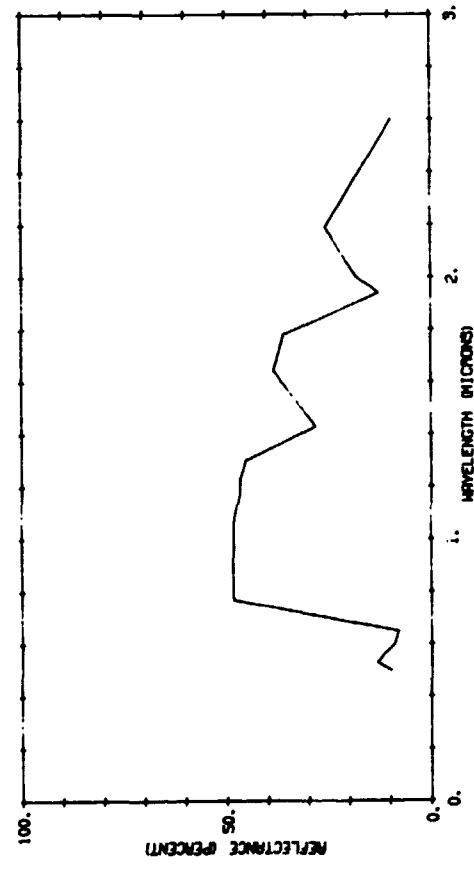
B09007 229

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



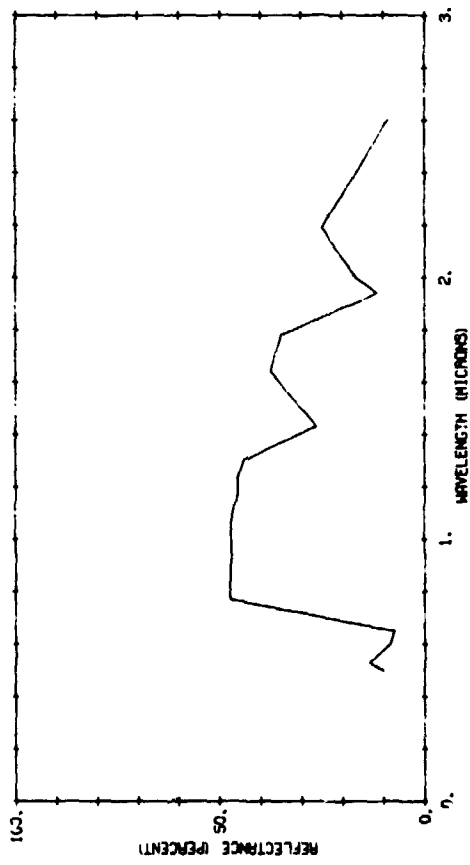
B09007 231

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



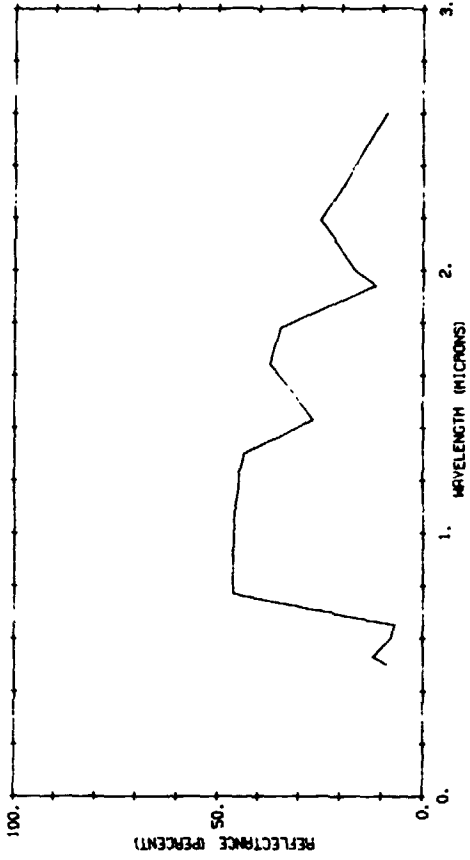
B09007 233

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



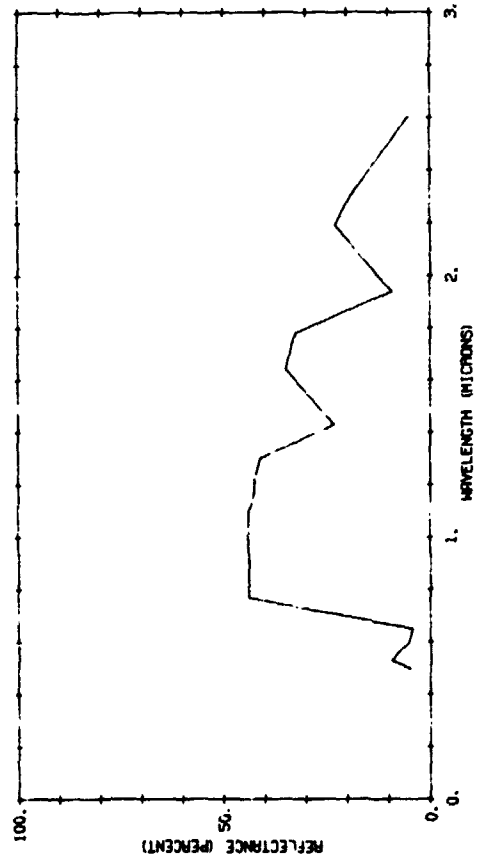
B09007 234

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



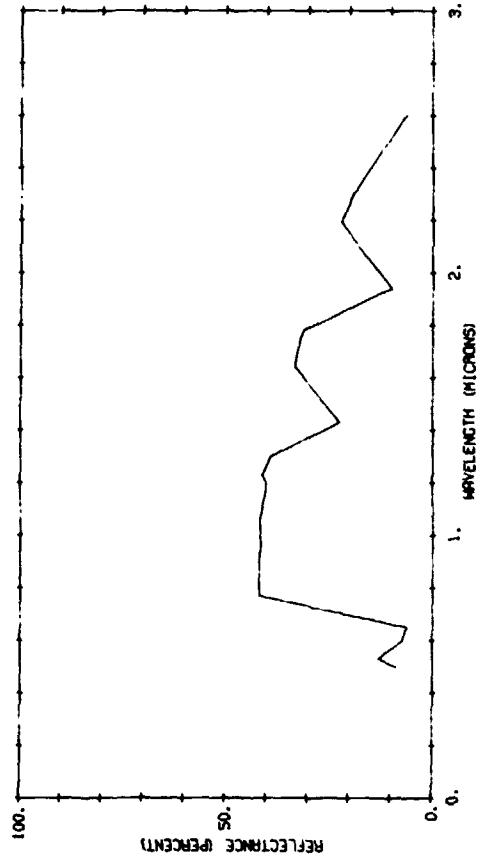
B09007 235

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



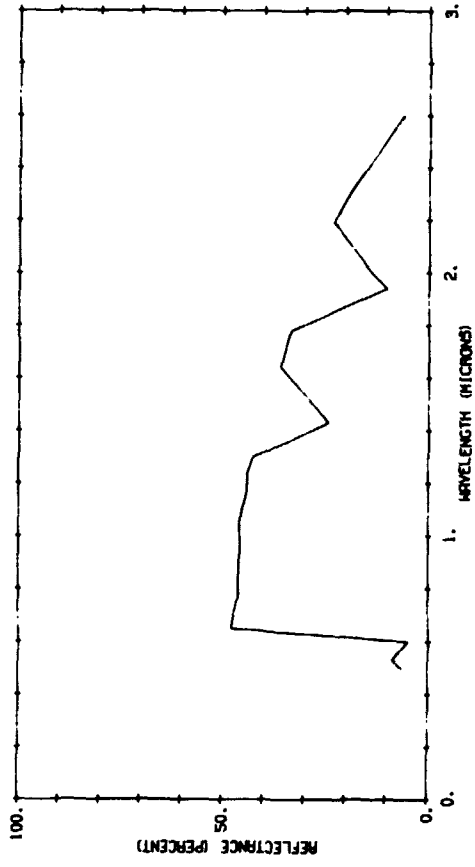
B09007 236

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



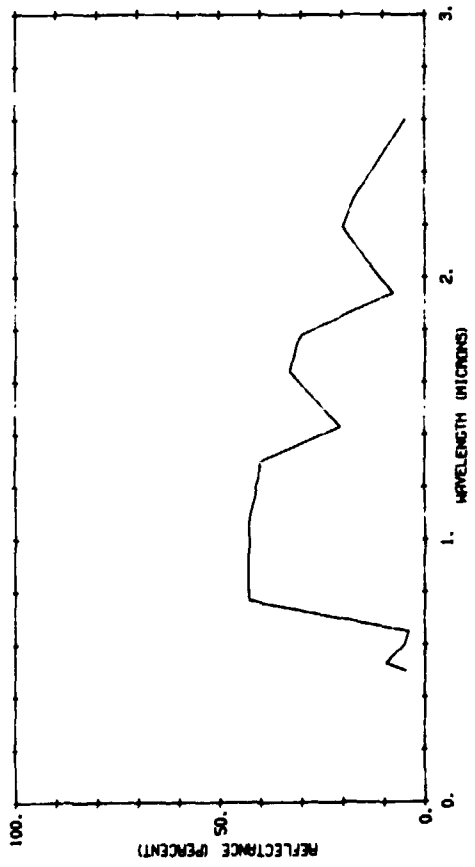
809007 238

TREE 6, LEAF 1. NO WATER SINCE 1 MAY



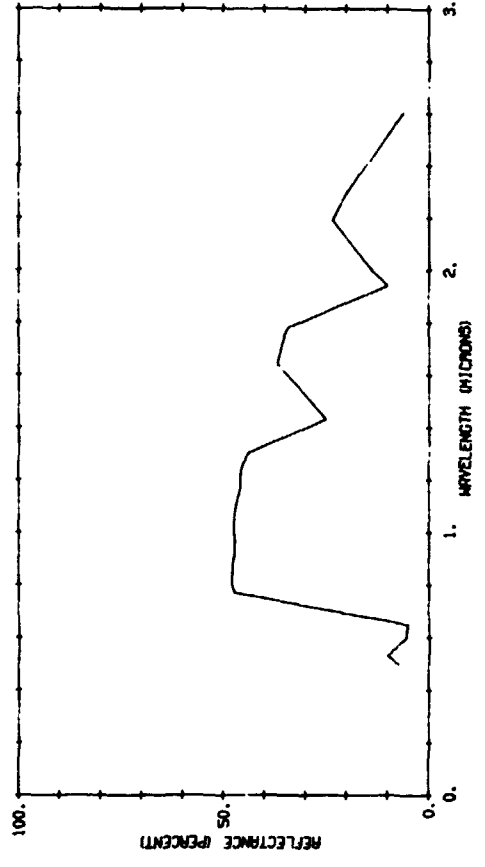
809007 237

TREE 6, LEAF 3. NO WATER SINCE 1 MAY



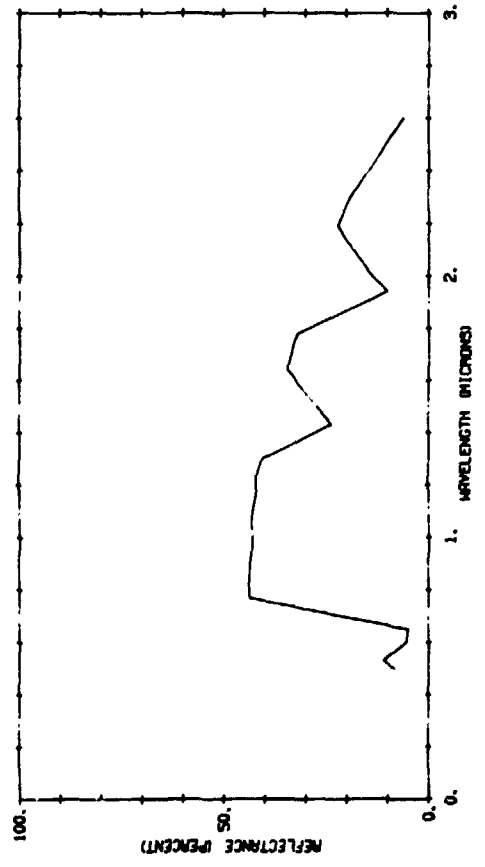
809007 240

TREE 5, LEAF 3. NO WATER SINCE 1 MAY.



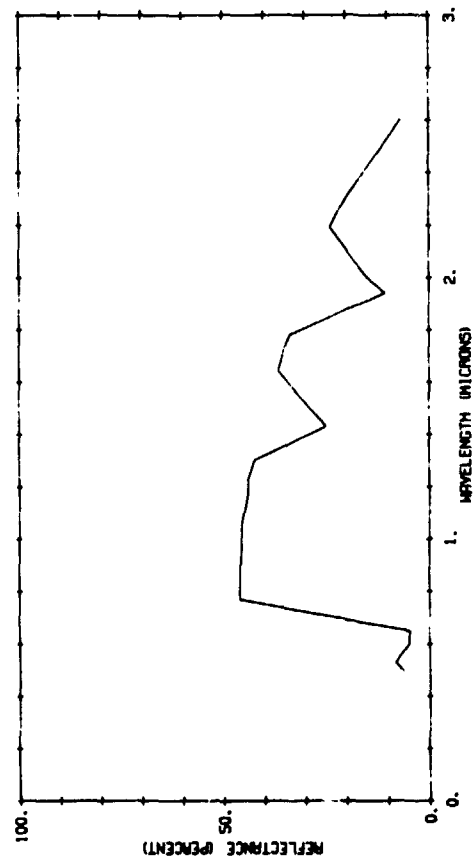
809007 239

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



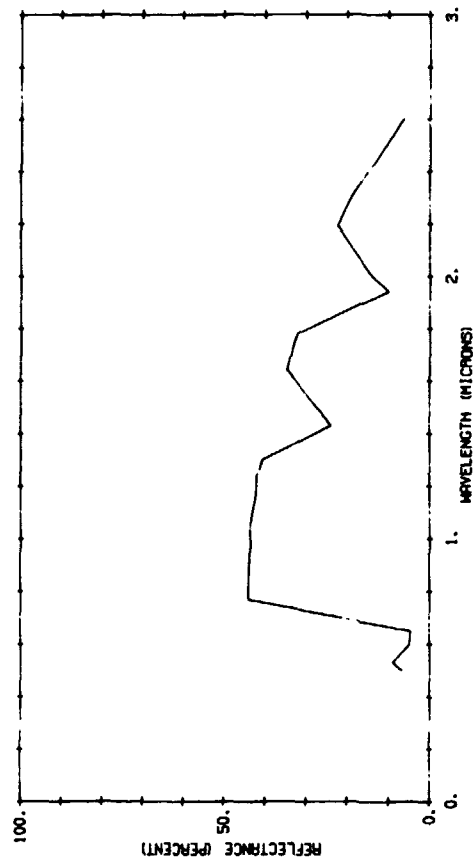
B09007 241

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



B09007 242

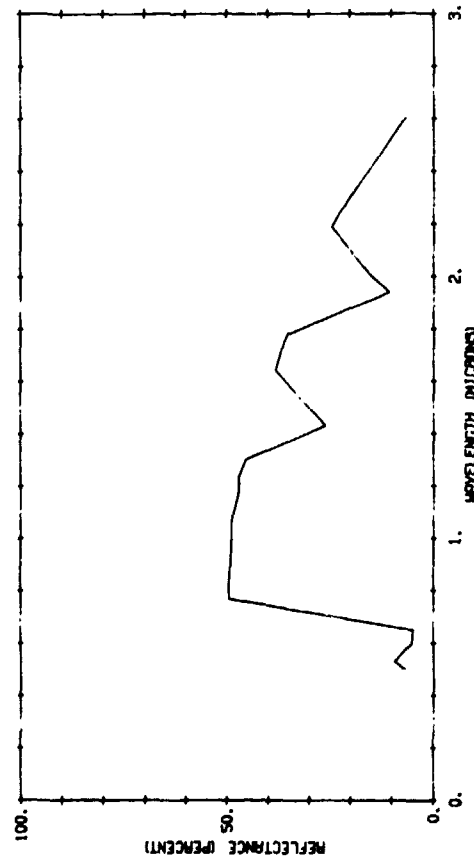
TREE 6. LEAF 2. NO WATER SINCE 1 MAY.



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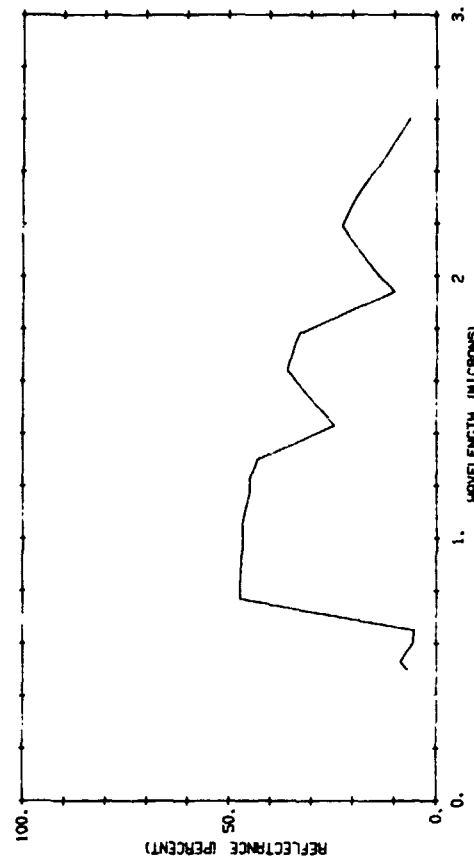
B09007 243

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



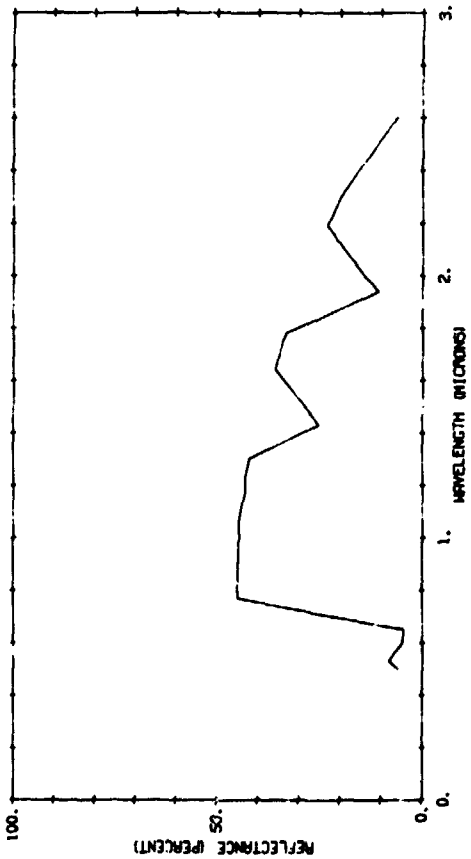
B09007 244

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



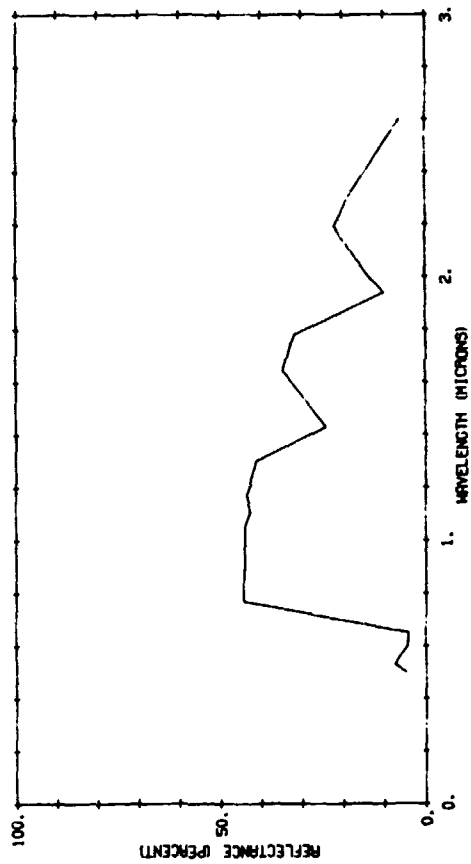
809007 245

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



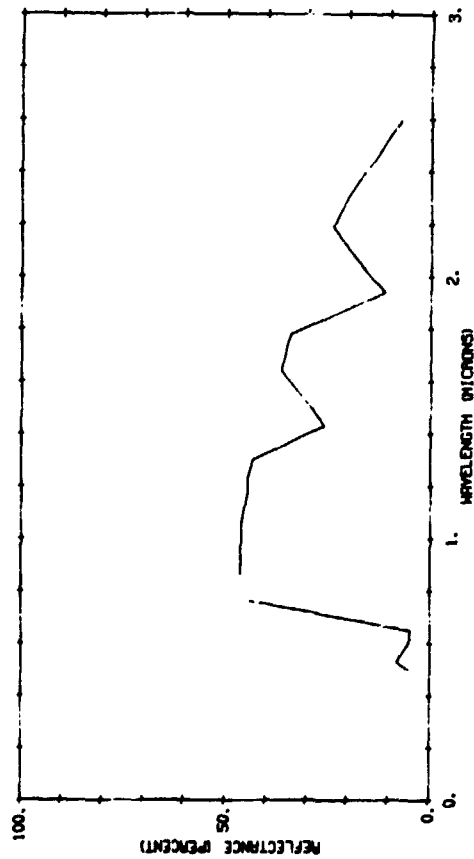
809007 246

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



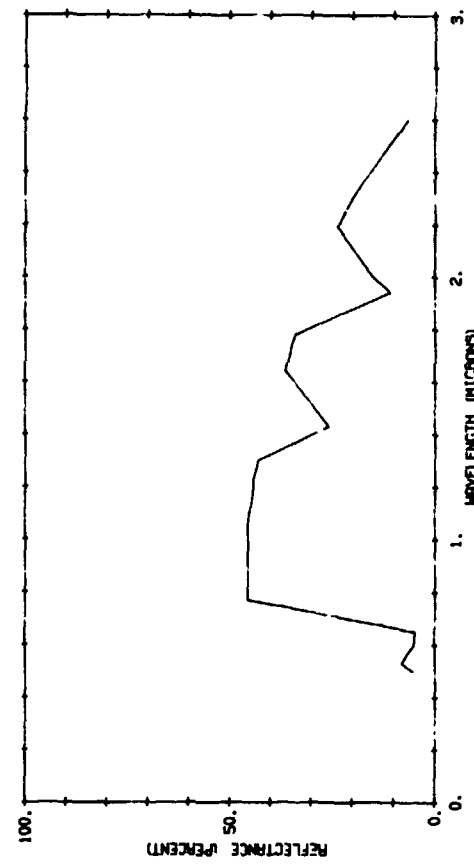
809007 247

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



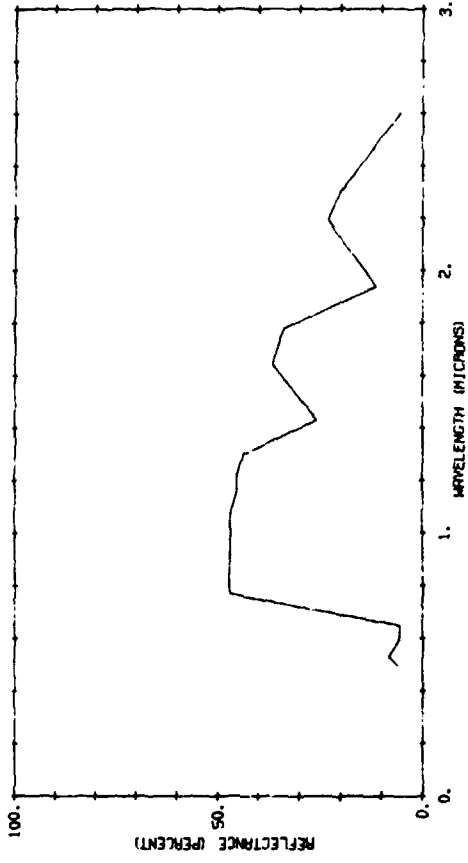
809007 248

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



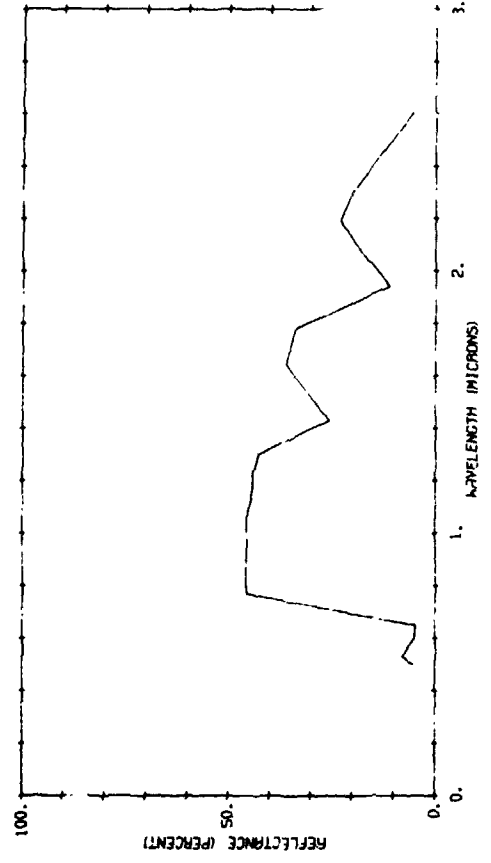
809007 250

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



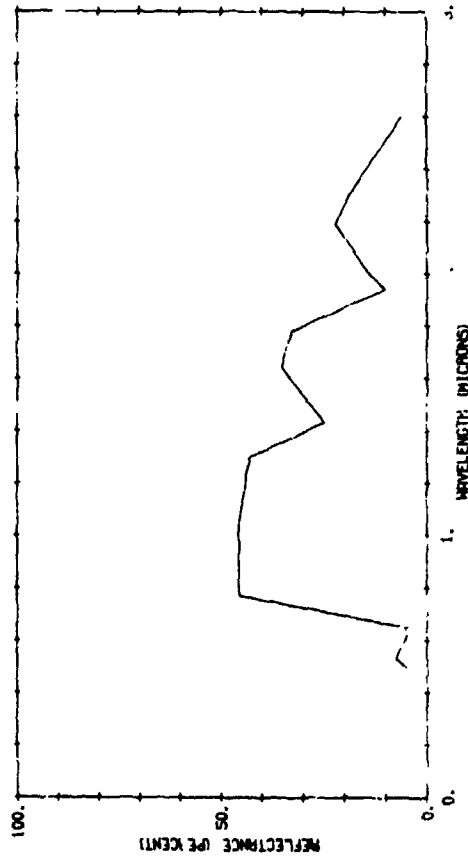
809007 252

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



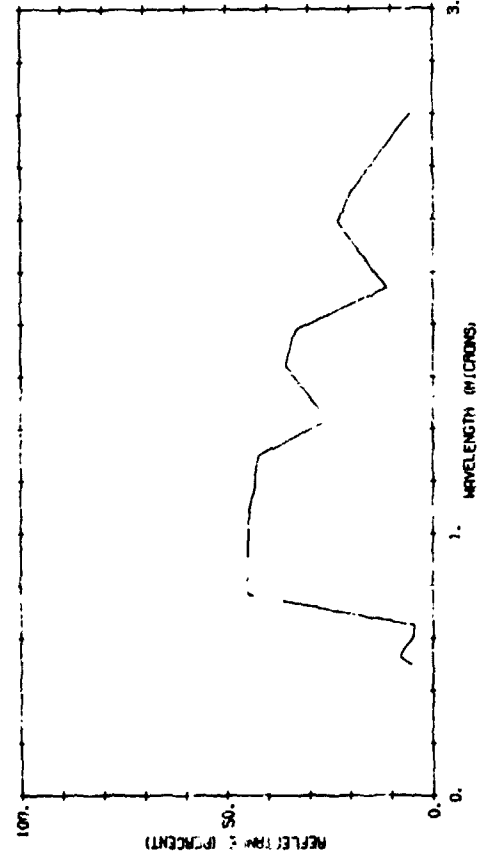
809007 249

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



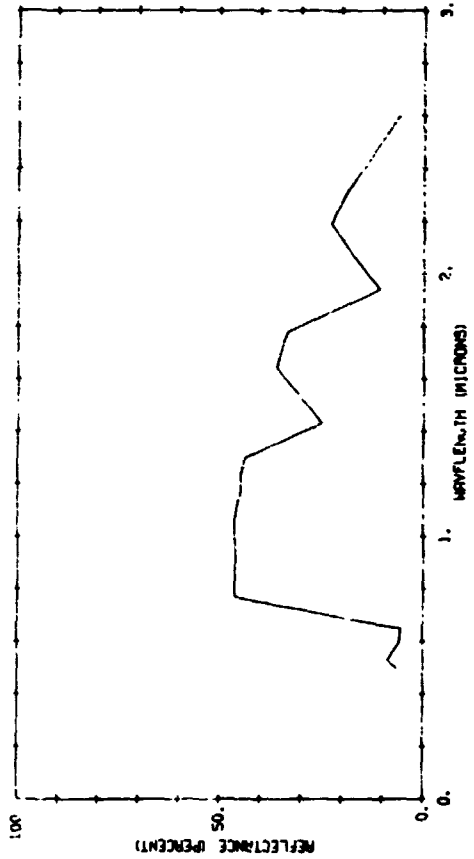
809007 251

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



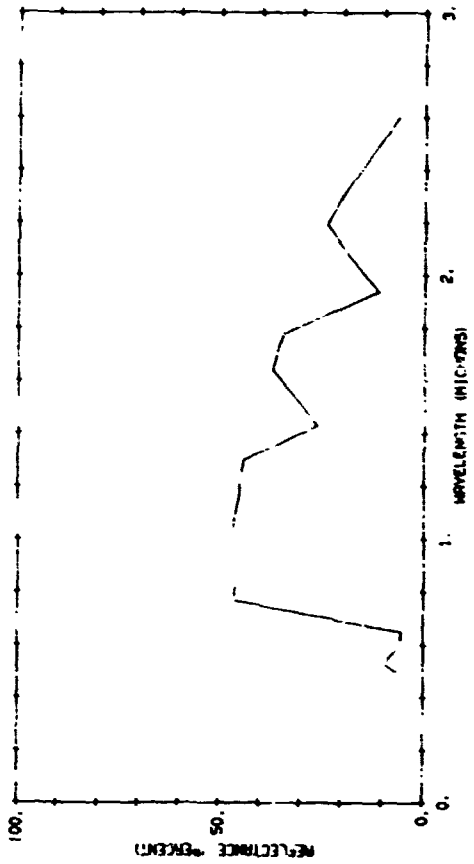
809007 253

THREE LEAF 1 NO WATER SINCE 1 MAY



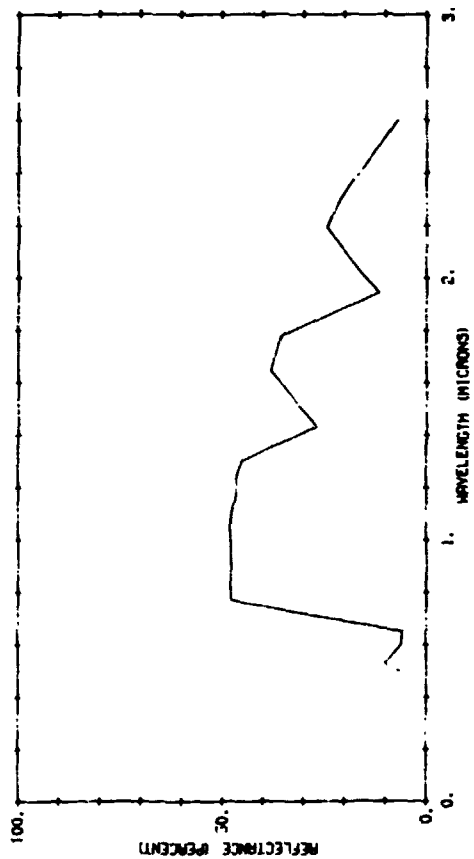
809007 254

FIVE LEAF 2 NO WATER SINCE 1 MAY



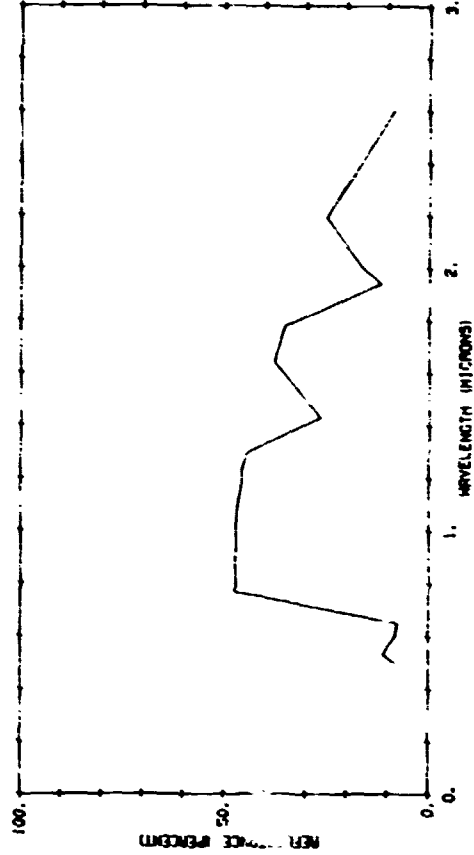
809007 255

THREE LEAF 3 NO WATER SINCE 1 MAY



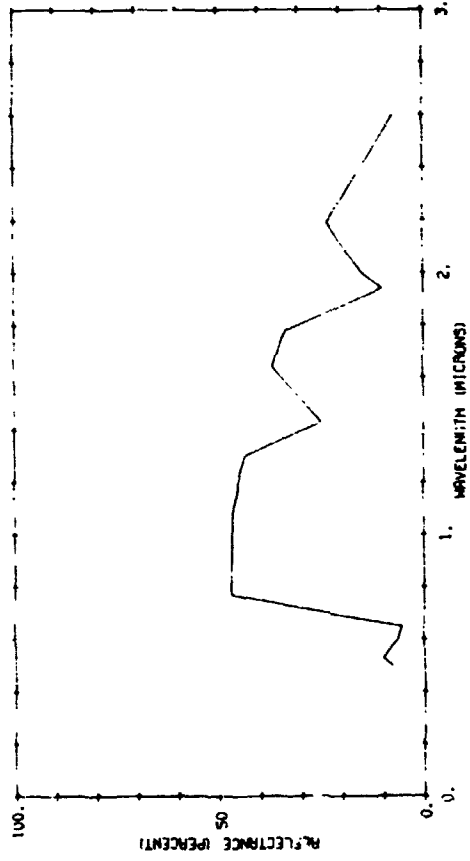
809007 256

THREE LEAF 1 NO WATER SINCE 1 MAY



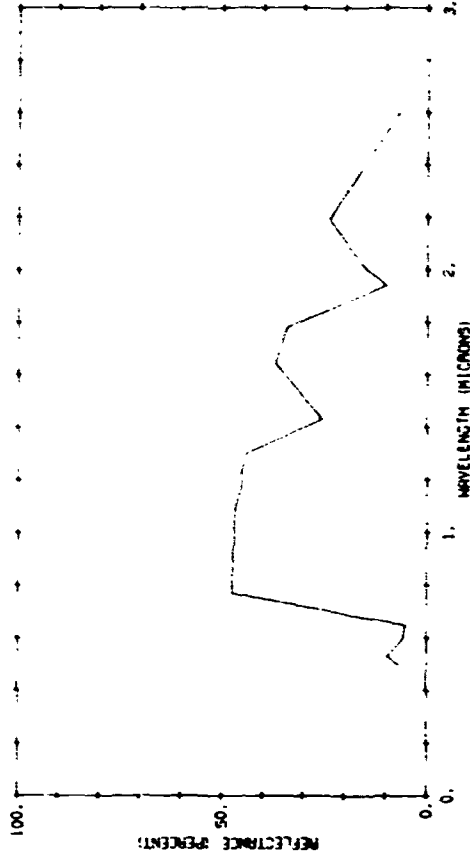
809007 257

TREE 6. LEAF 1. NO WATER SINCE 1 MAY



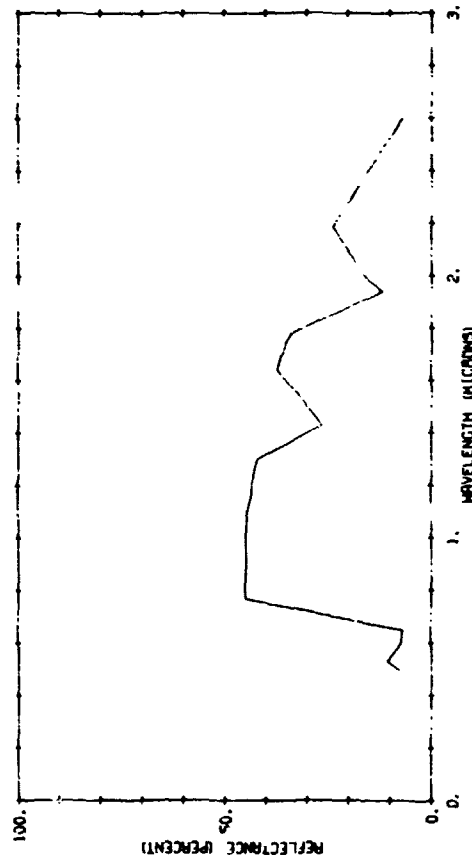
809007 258

TREE 6. LEAF 1. NO WATER SINCE 1 MAY



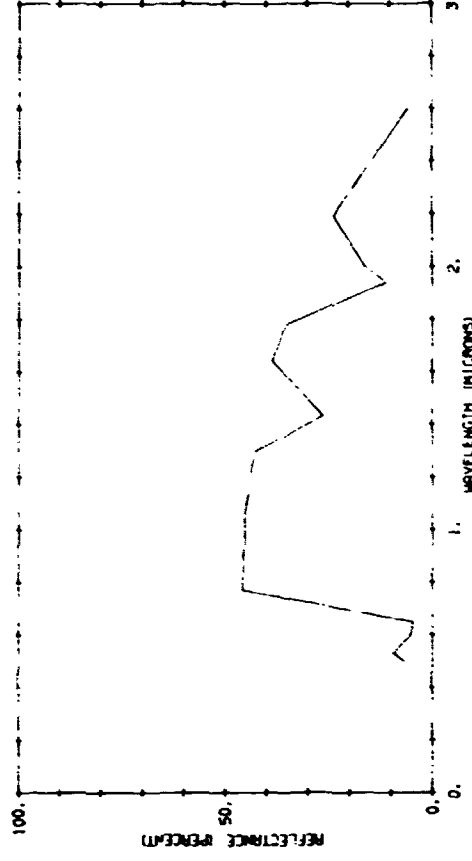
809007 259

TREE 6. LEAF 1. NO WATER SINCE 1 MAY



809007 260

TREE 6. LEAF 1. NO WATER SINCE 1 MAY



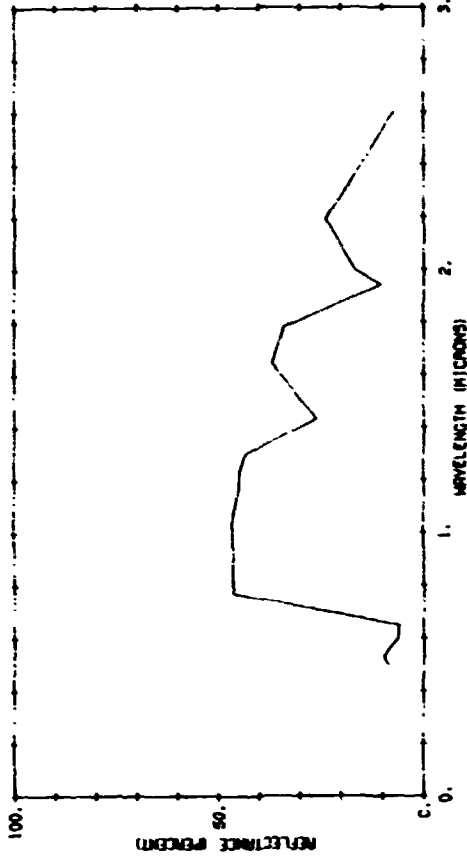
809007 261

TREE 6, LEAF 3 NO WATER SINCE 1 MAY



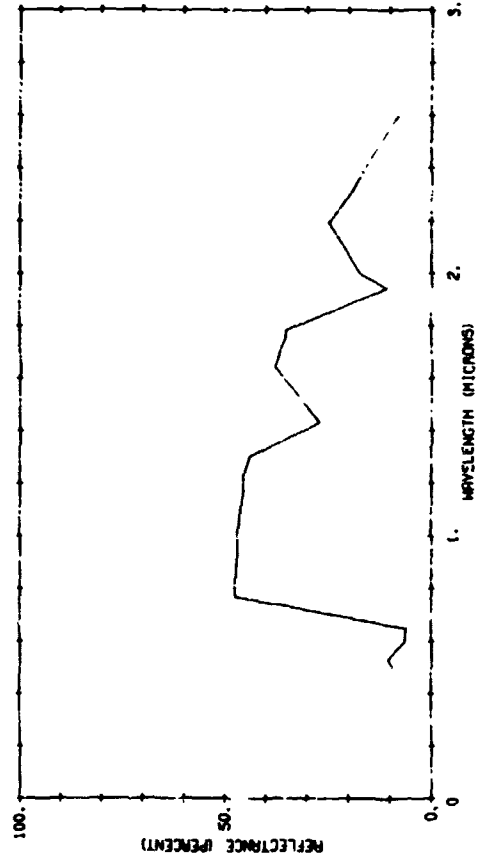
809007 262

TREE 6, LEAF 1 NO WATER SINCE 1 MAY



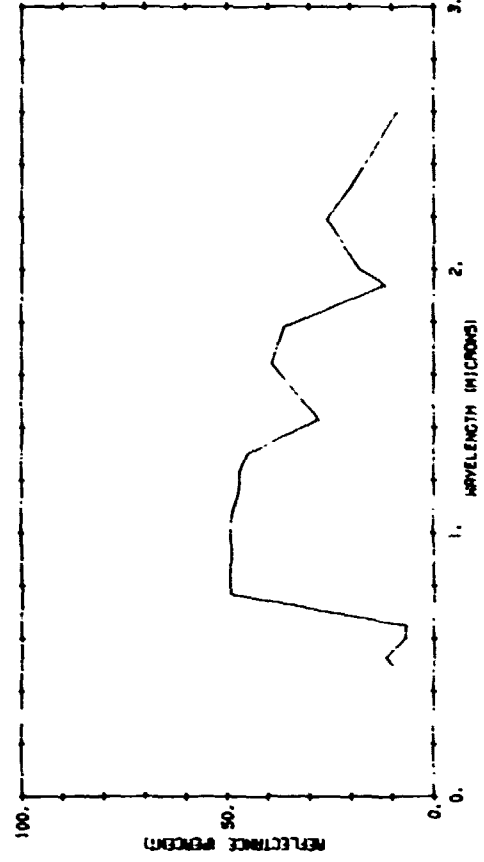
809007 263

TREE 6, LEAF 2 NO WATER SINCE 1 MAY



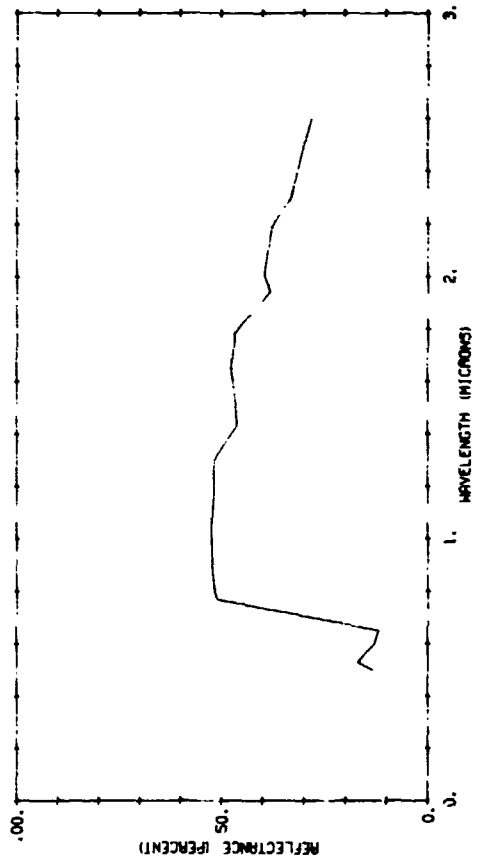
809007 264

TREE 6, LEAF 3 NO WATER SINCE 1 MAY



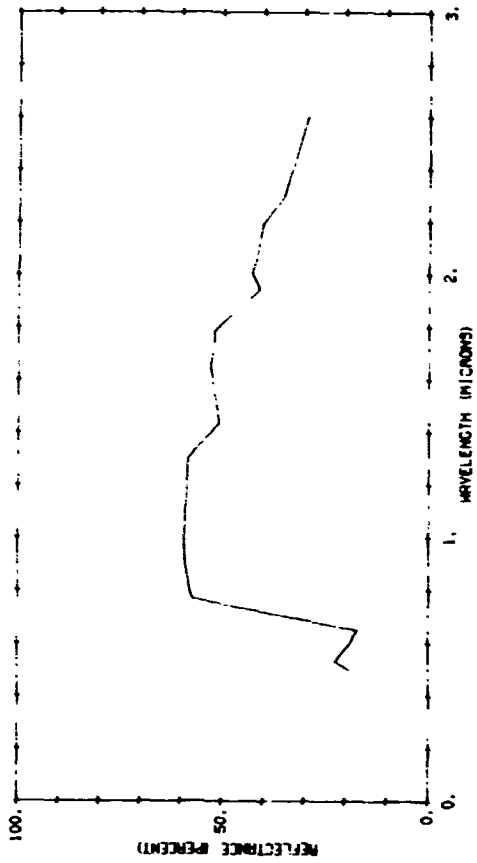
809007 265

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



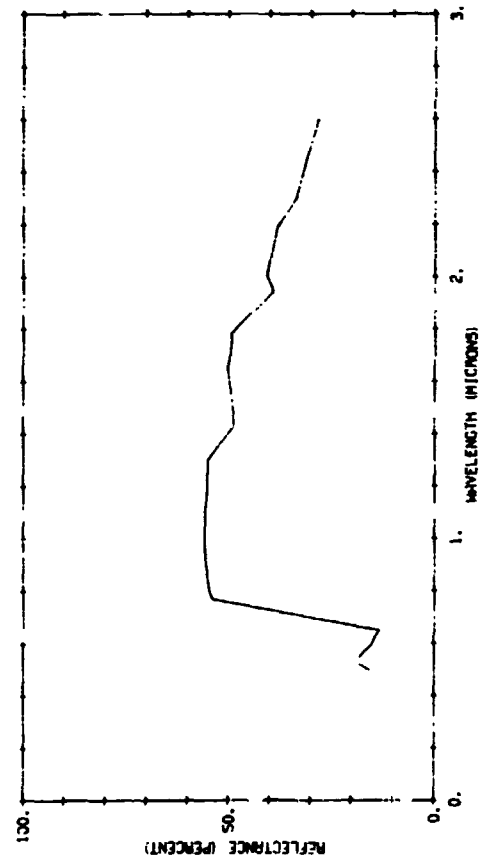
809007 266

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



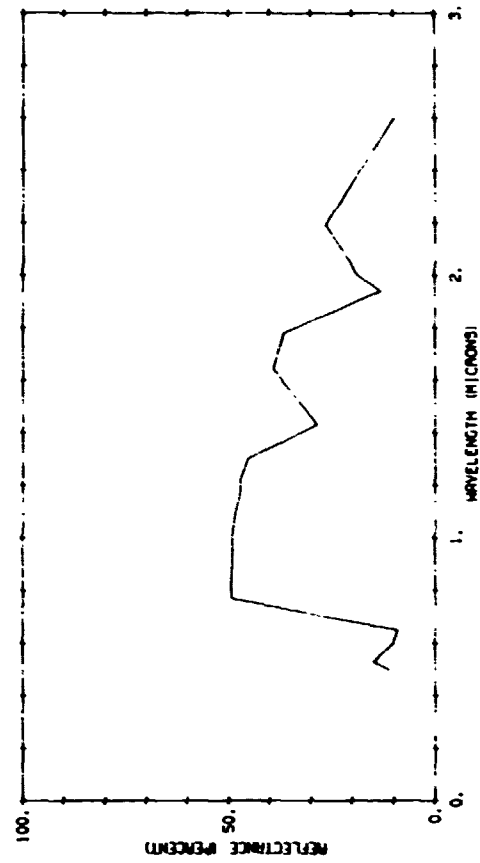
809007 267

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



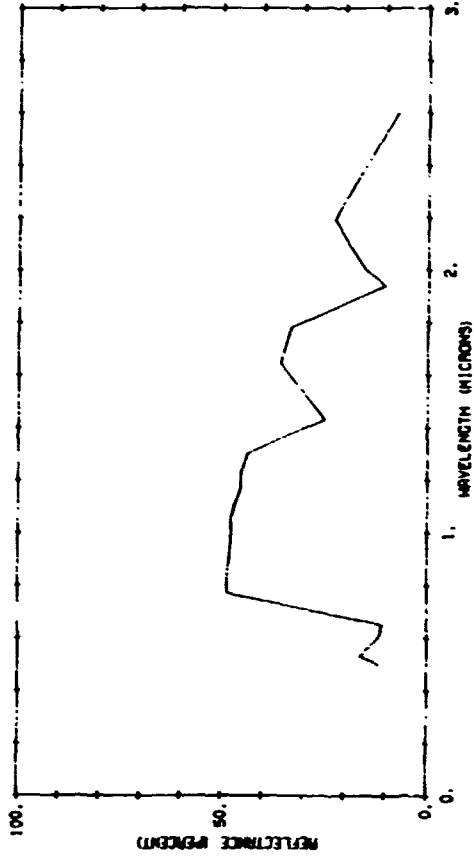
809007 269

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



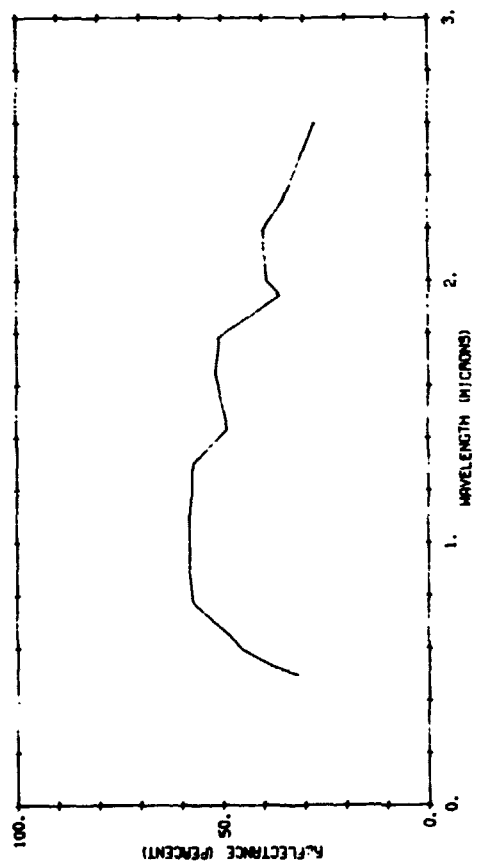
809007 270

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



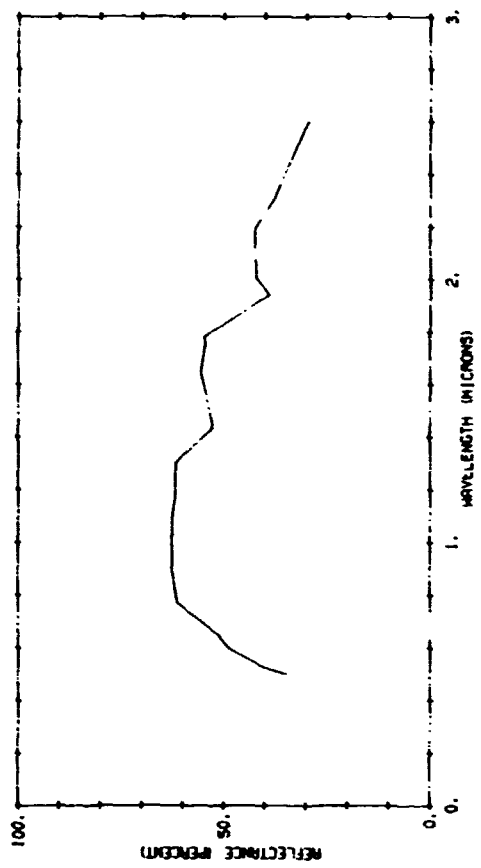
809007 271

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.



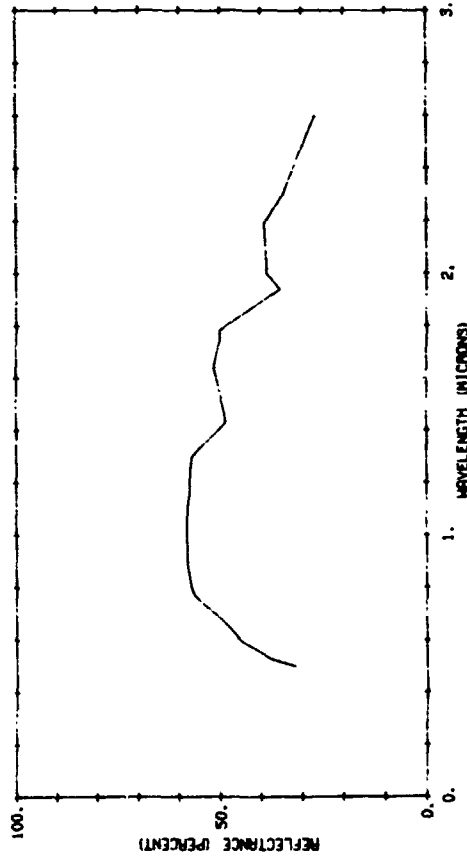
809007 272

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.



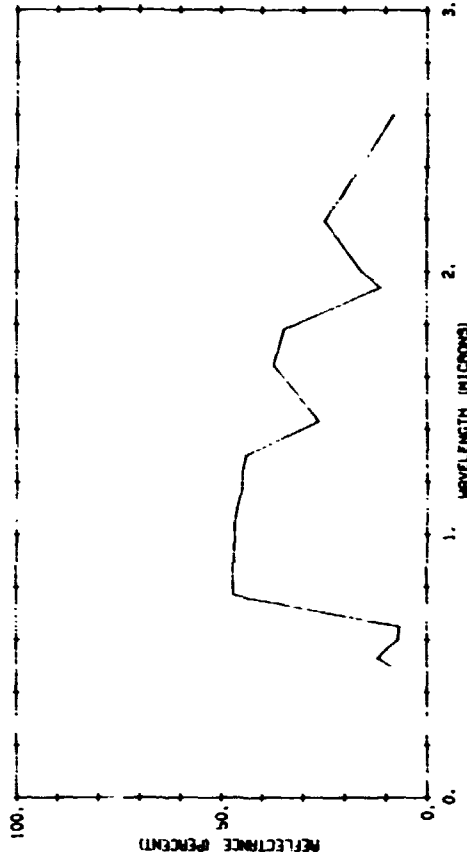
809007 273

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



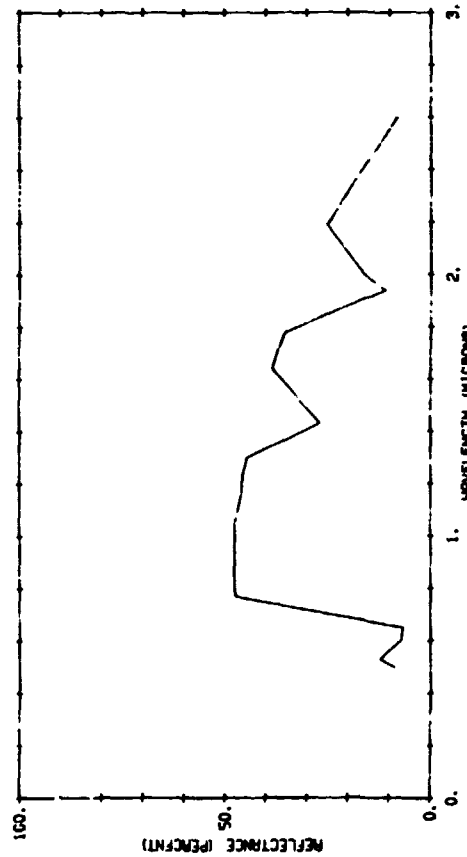
809007 274

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



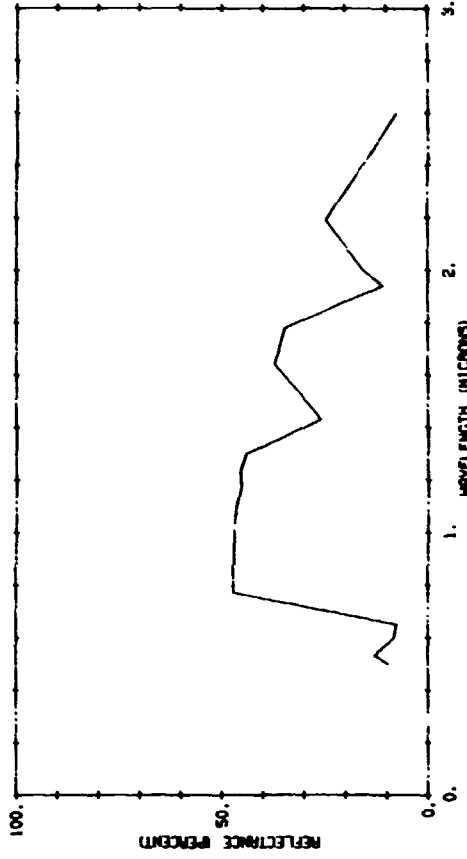
809007 275

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



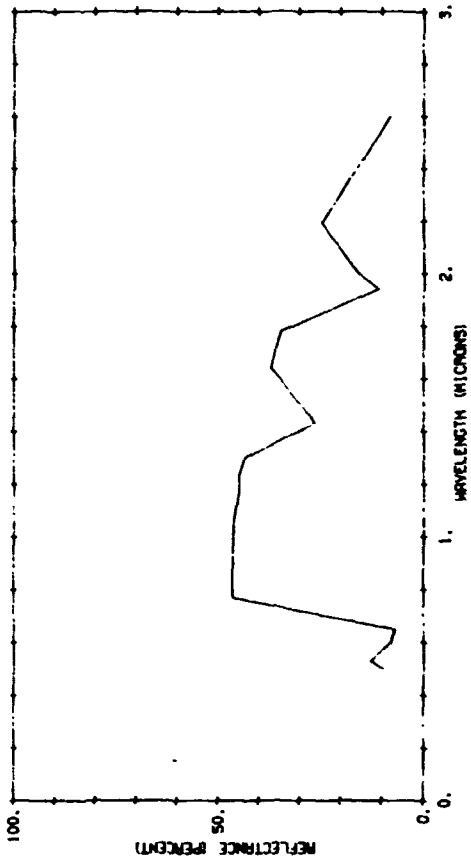
809007 276

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



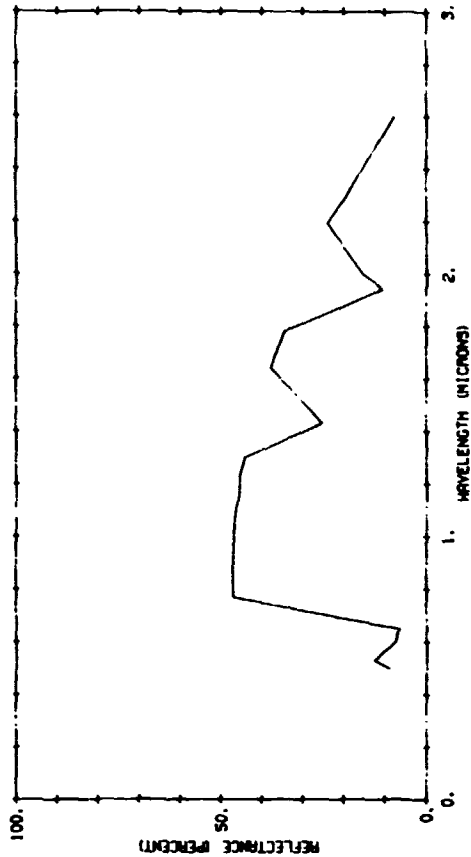
B09007 278

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.

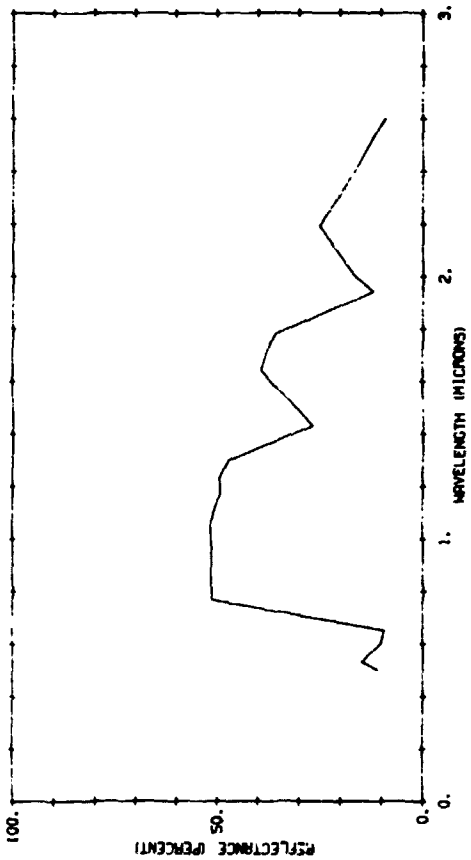


B09007 280

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.

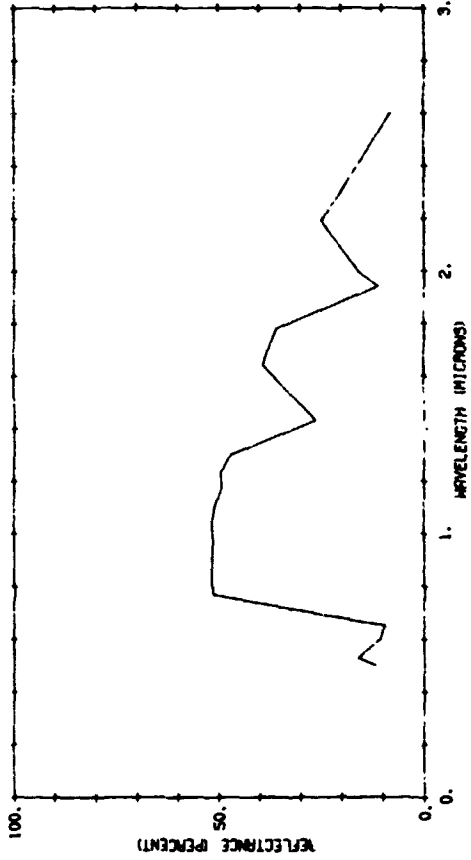


TREE 6, LEAF 3. NO WATER 1 MAY TO 12 JULY, WATERED ON 13 JUNE AND EVERY SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN. CURVE FROM GREEN PORTION ONLY.



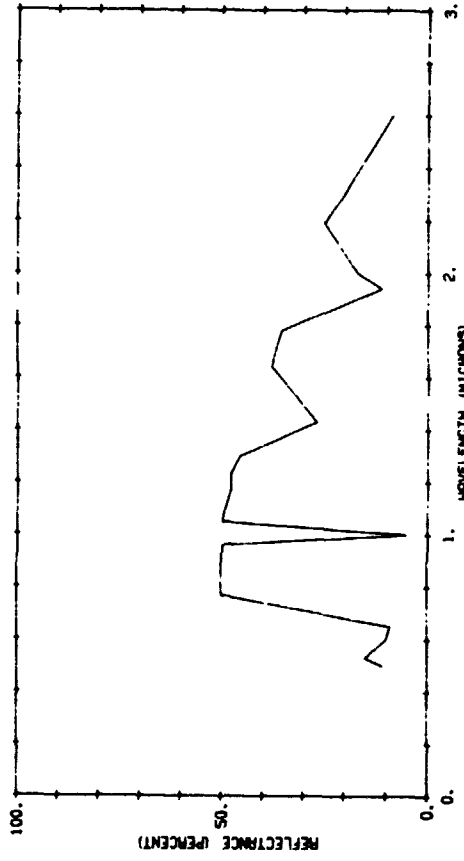
B09007 279

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.



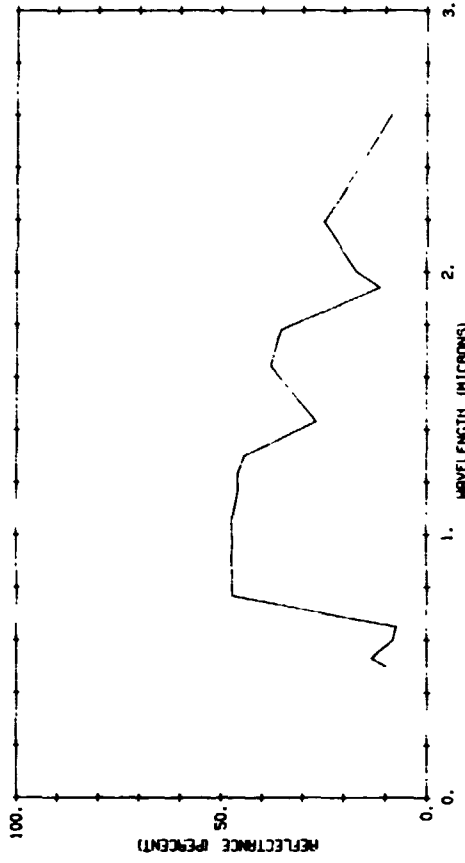
B09007 281

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.



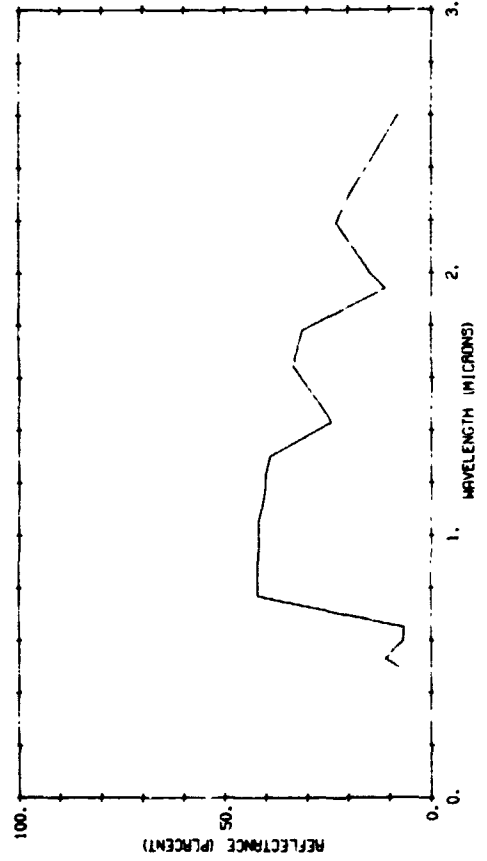
B09007 282

TREE 6, LEAF 3. NO WATER 1 MAY TO 12 JULY. WATERED ON 13 JUNE AND EVERY 7 SECOND OR THIRD DAY THEREAFTER. LEAF PARTIALLY BROWN (DEAD) AND PARTIALLY GREEN. CURVE FROM GREEN PORTION ONLY.



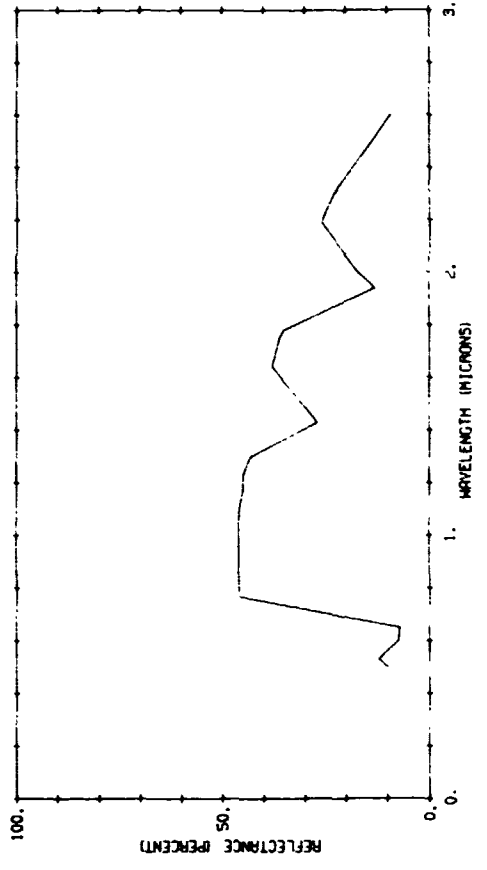
B09007 283

TREE 7, LEAF 1. NO WATER SINCE 1 MAY



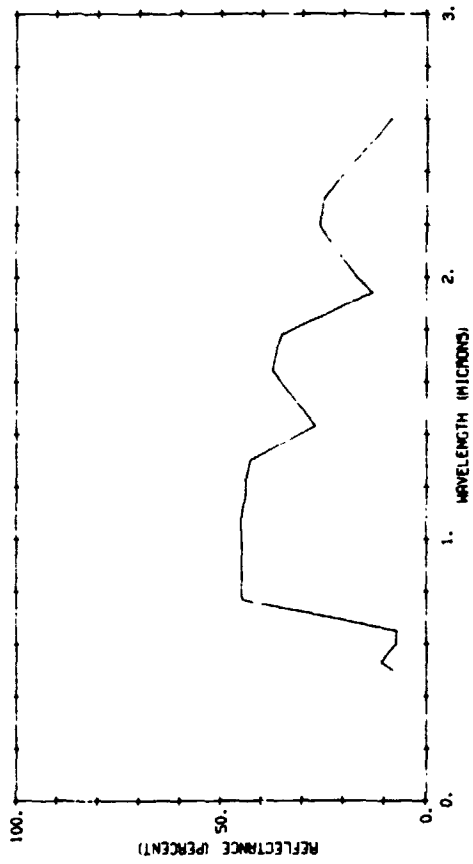
B09007 284

TREE 7, LEAF 2. NO WATER SINCE 1 MAY



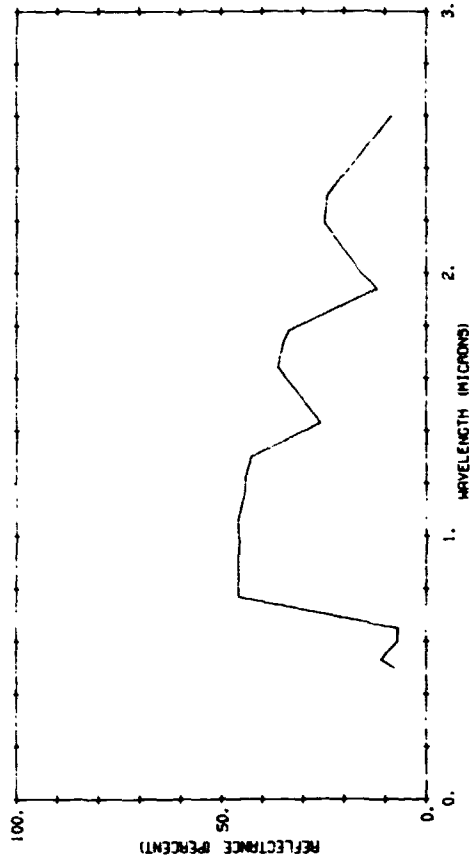
809007 285

TREE 7, LEAF 1 NO WATER SINCE 1 MAY



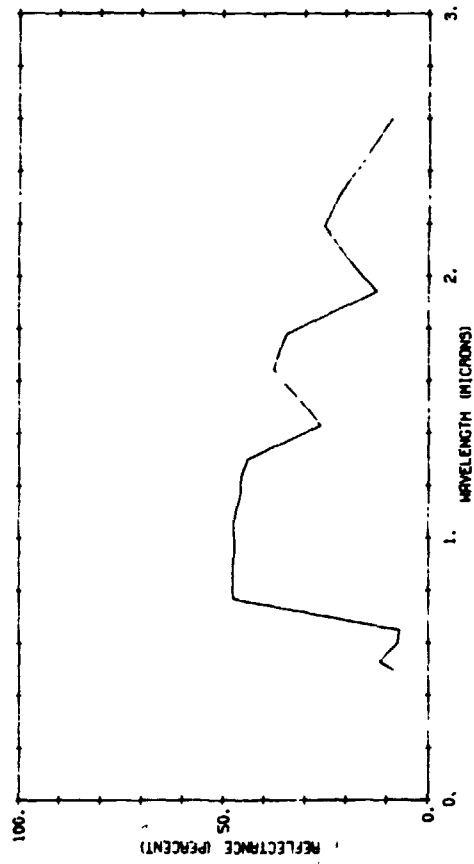
809007 286

TREE 7, LEAF 2 NO WATER SINCE 1 MAY



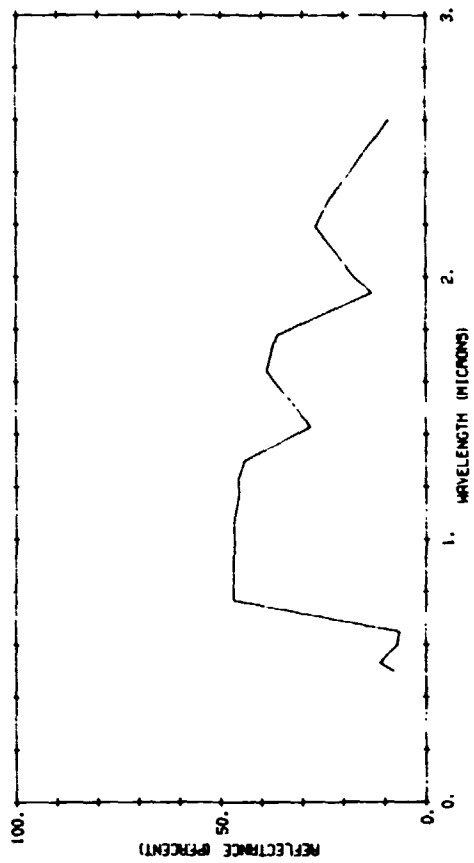
809007 287

TREE 7, LEAF 3 NO WATER SINCE 1 MAY



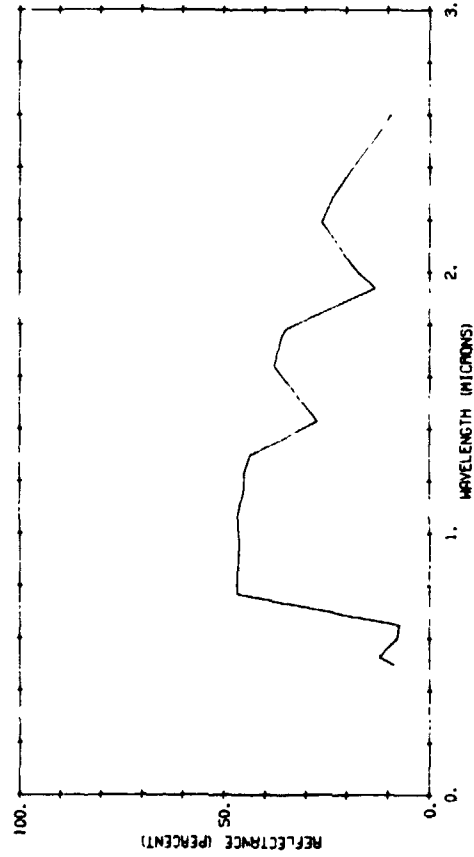
809007 288

TREE 7, LEAF 4 NO WATER SINCE 1 MAY



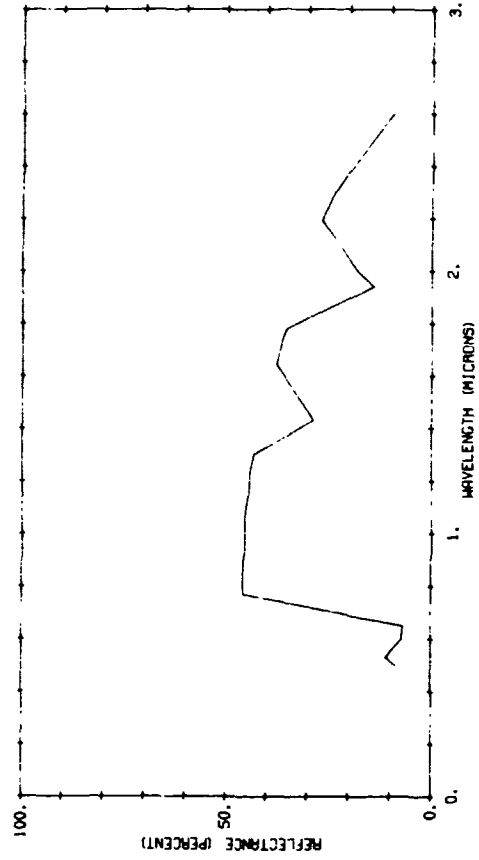
809007 239

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



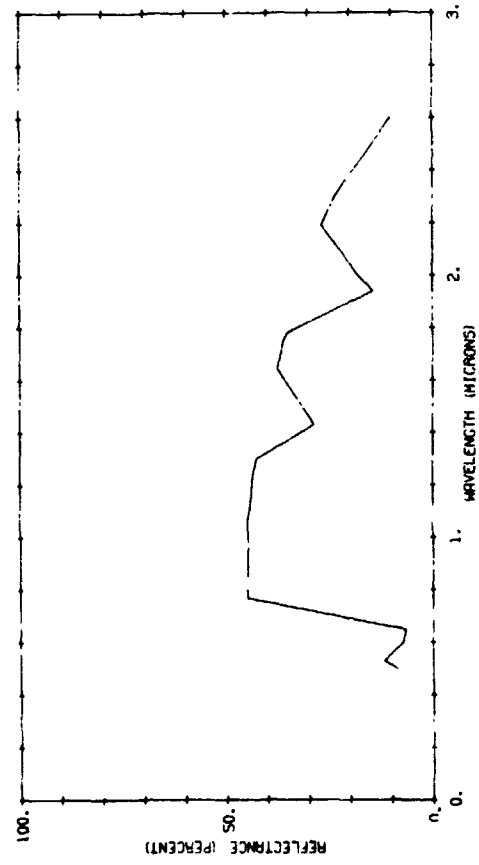
809007 290

TREE 7, LEAF 1 NO WATER SINCE 1 MAY.



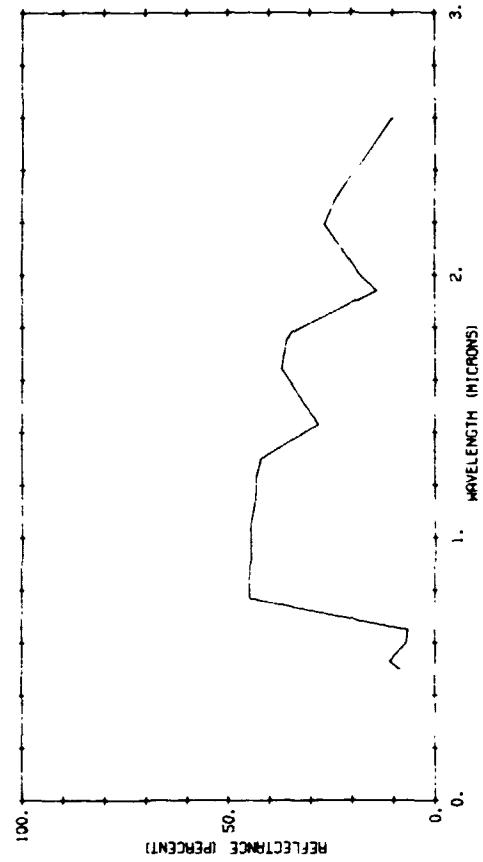
809007 291

TREE 7, LEAF 2 NO WATER SINCE 1 MAY



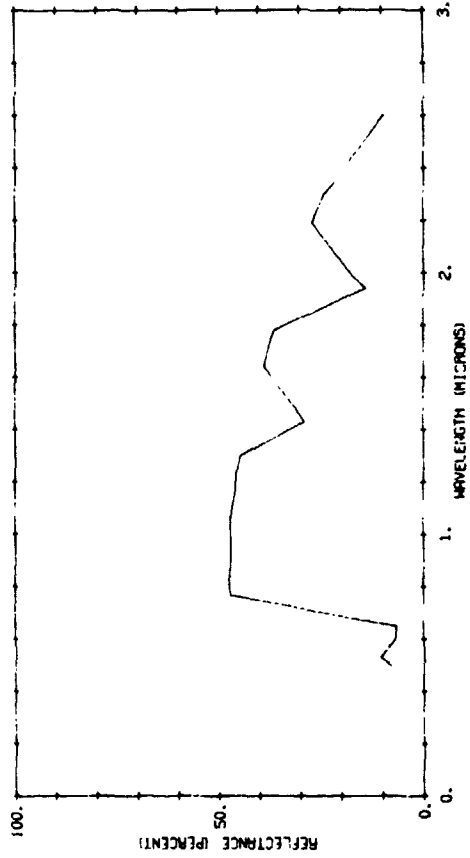
809007 292

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



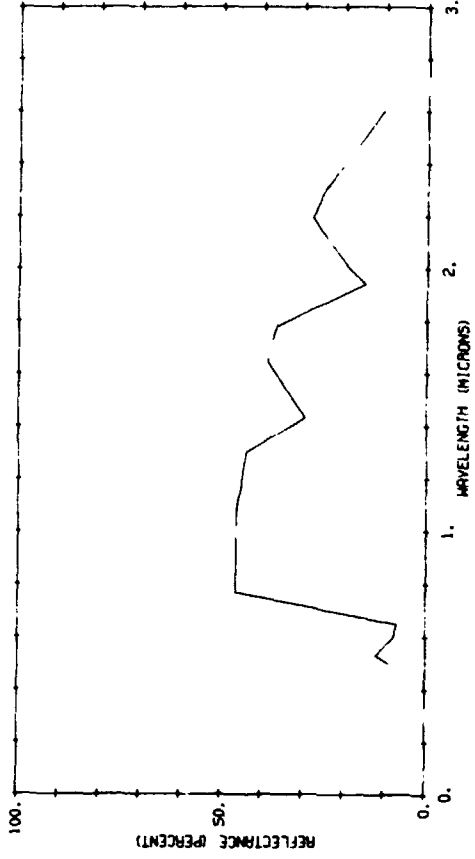
B09007 293

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



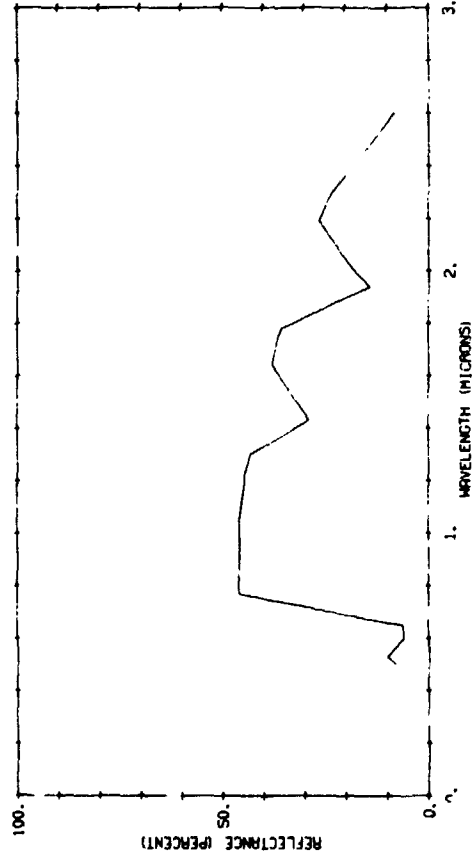
B09007 295

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



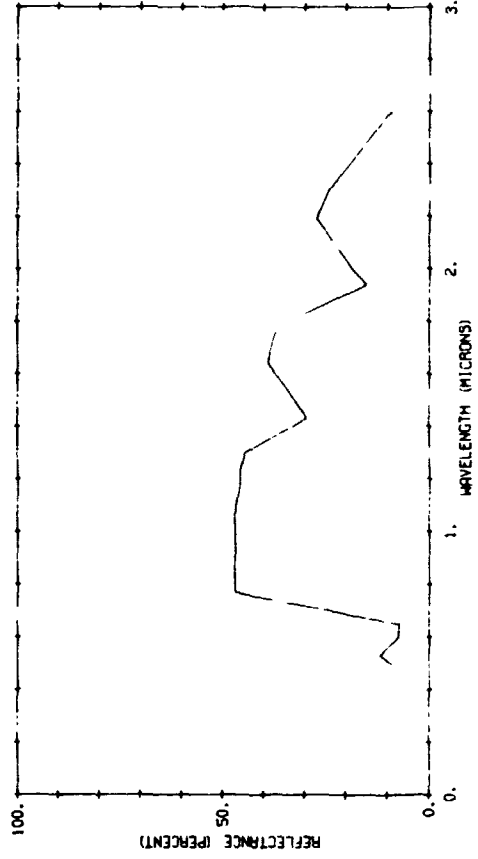
B09007 296

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



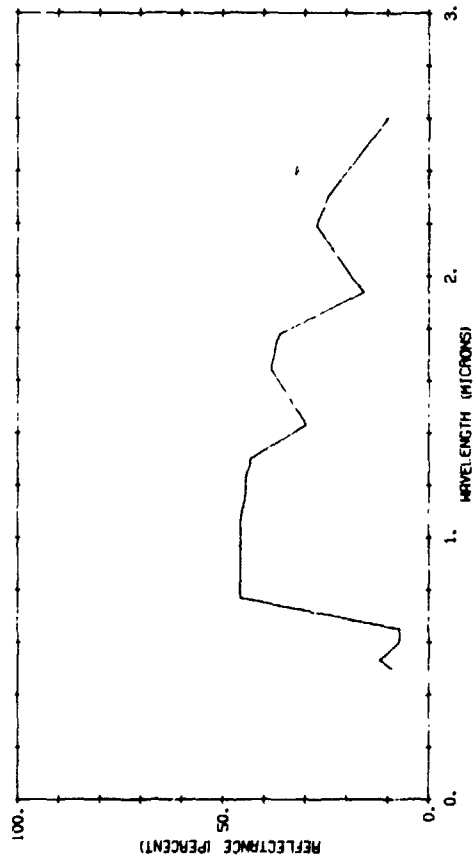
B09007 297

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



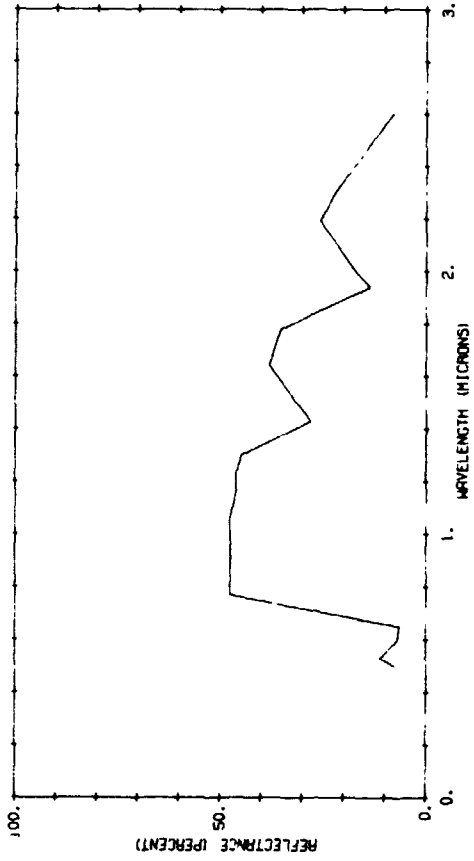
B09007 298

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



B09007 299

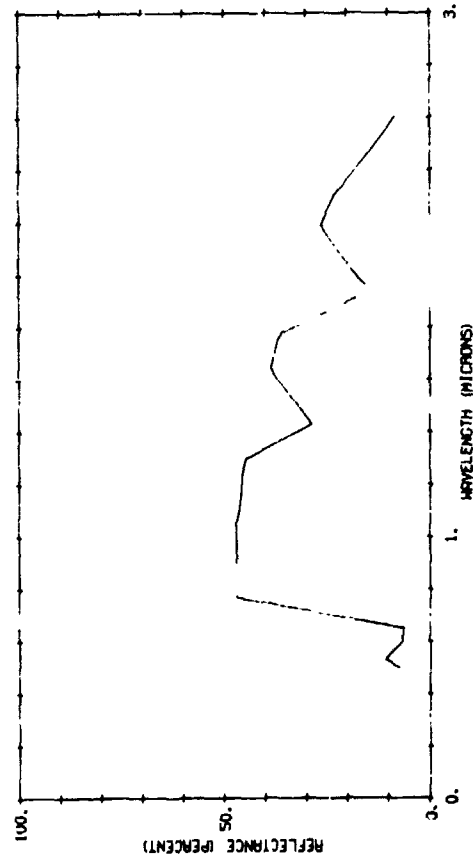
TREE 7, LEAF 1. NO WATER SINCE 1 MAY



6144-75

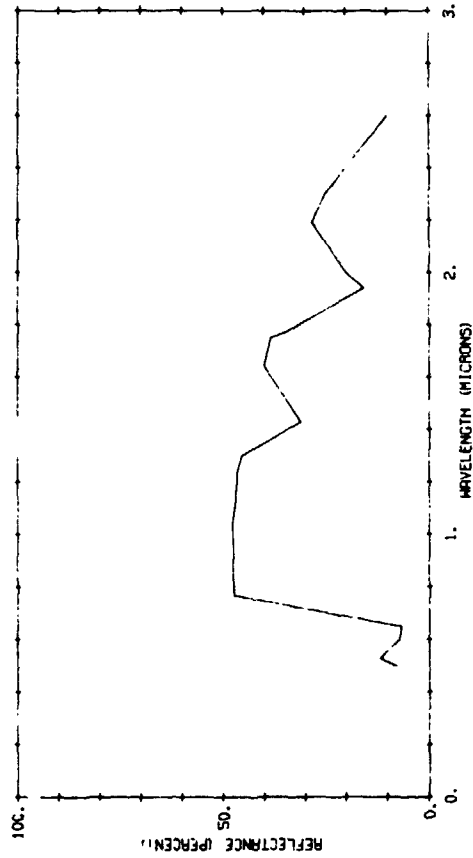
B09007 300

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



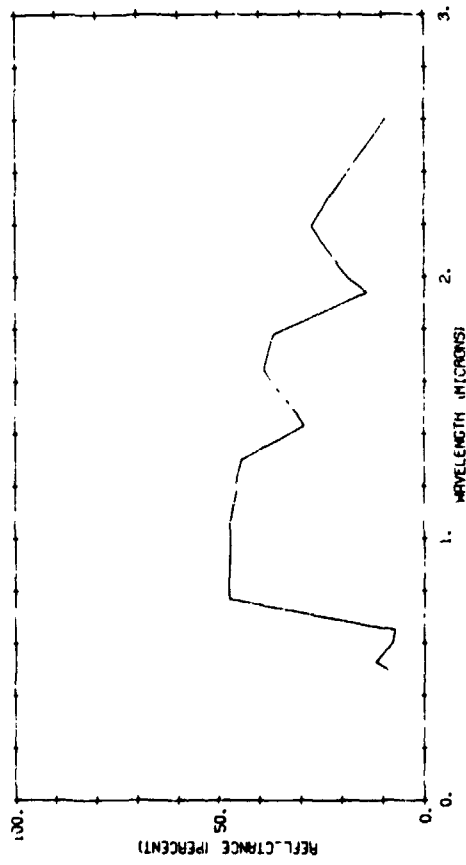
B09007 301

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



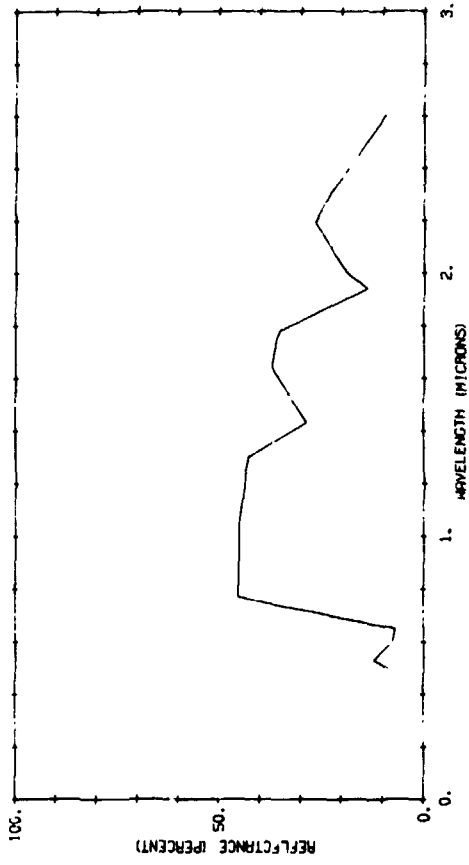
809007 302

TREE 7, LEAF 1, NO WATER SINCE 1 MAY



809007 303

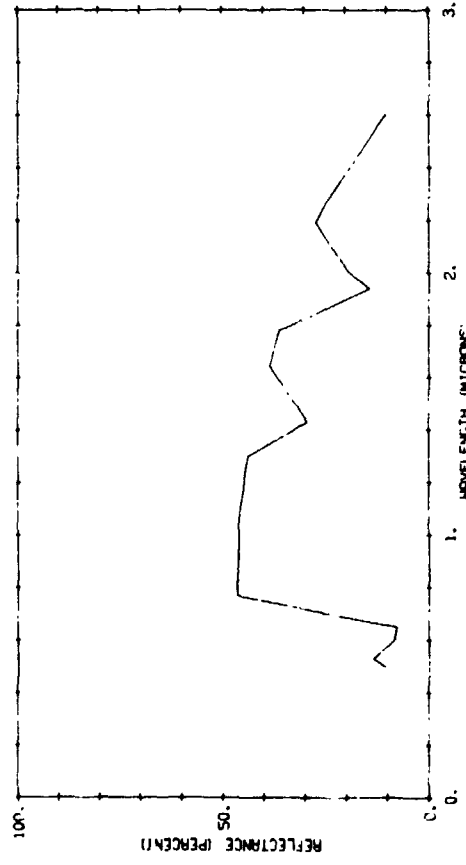
TREE 7, LEAF 2, NO WATER SINCE 1 MAY



9-44-70

809007 304

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



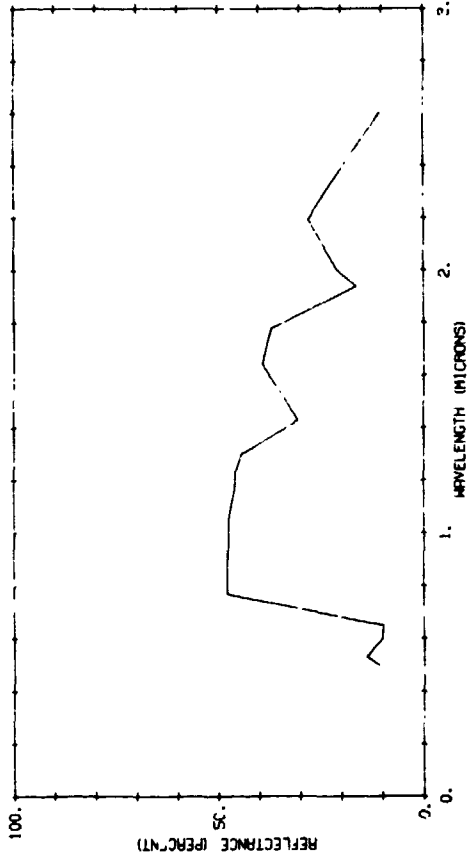
809007 305

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



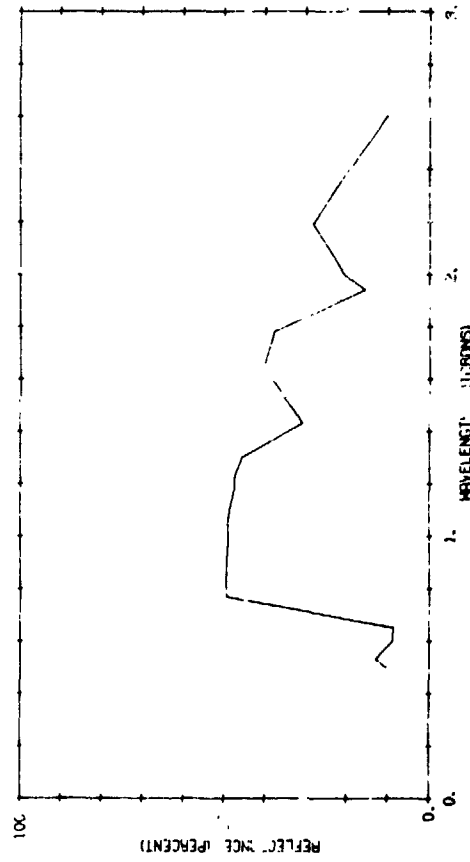
B09007 307

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



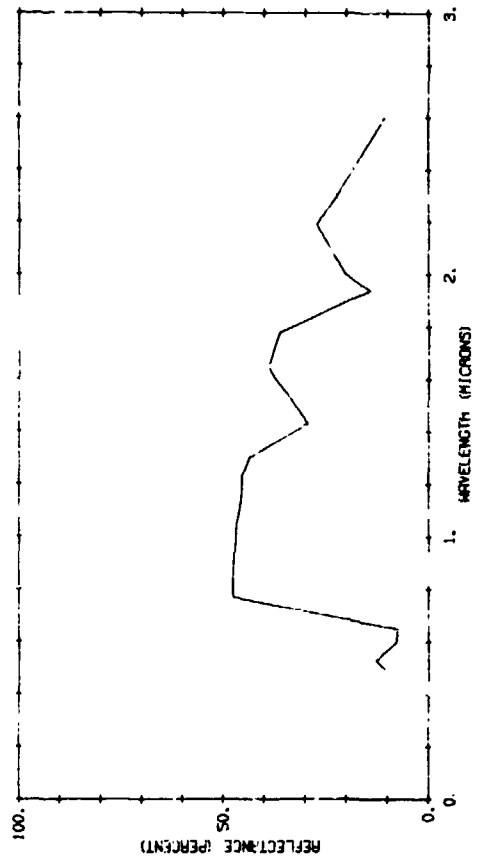
B09007 306

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



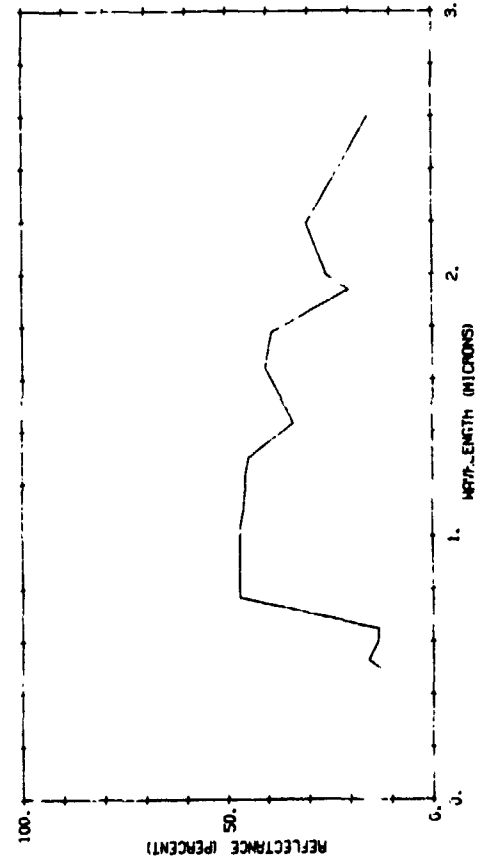
B09007 309

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



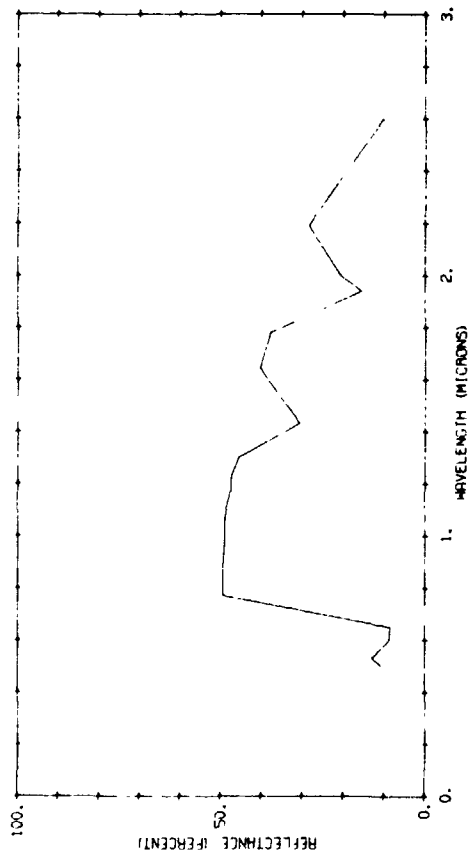
B09007 308

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



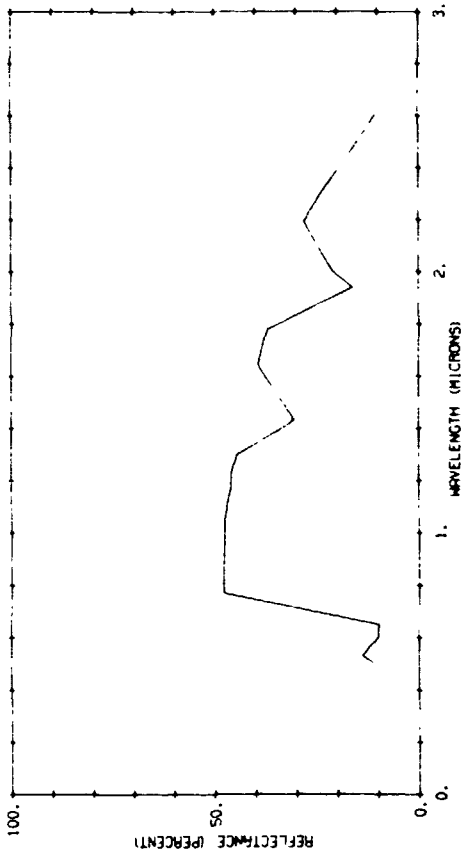
B09007 306

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



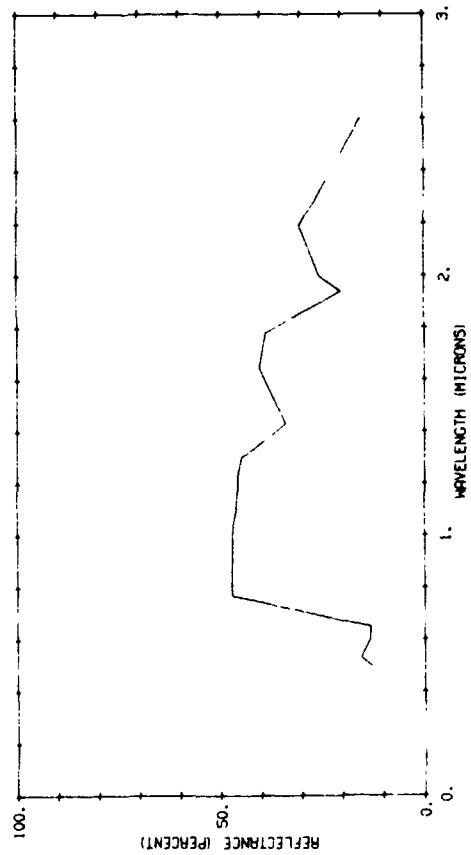
B09007 307

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



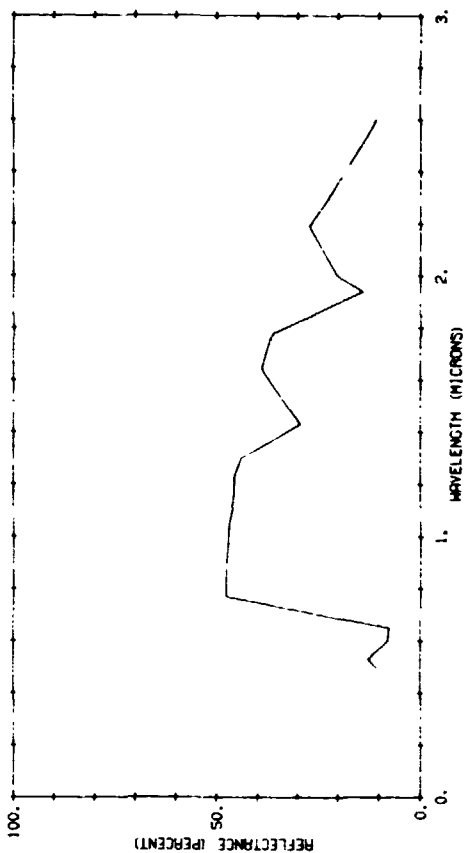
B09007 308

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



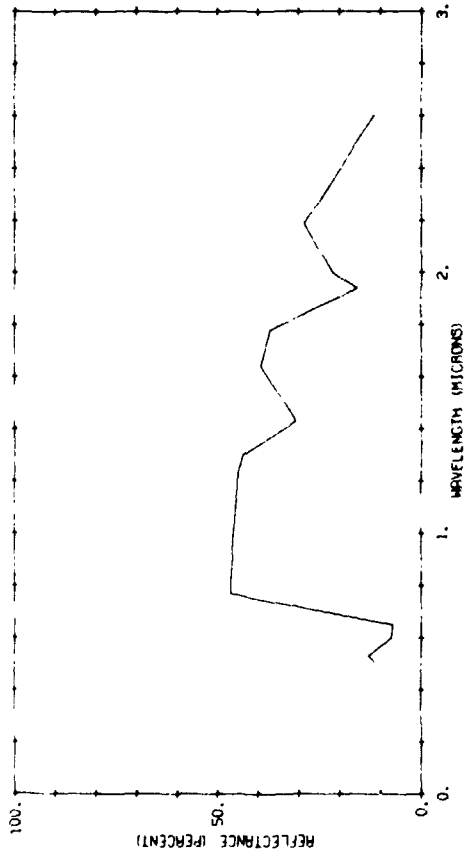
B09007 309

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



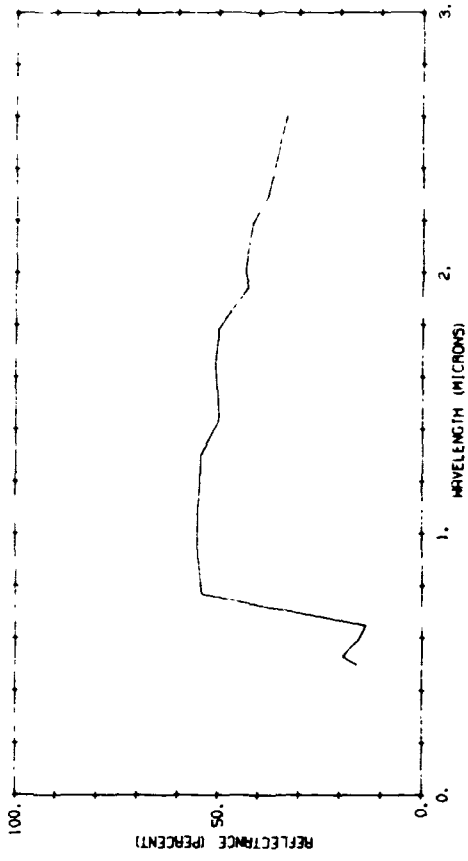
B09007 310

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



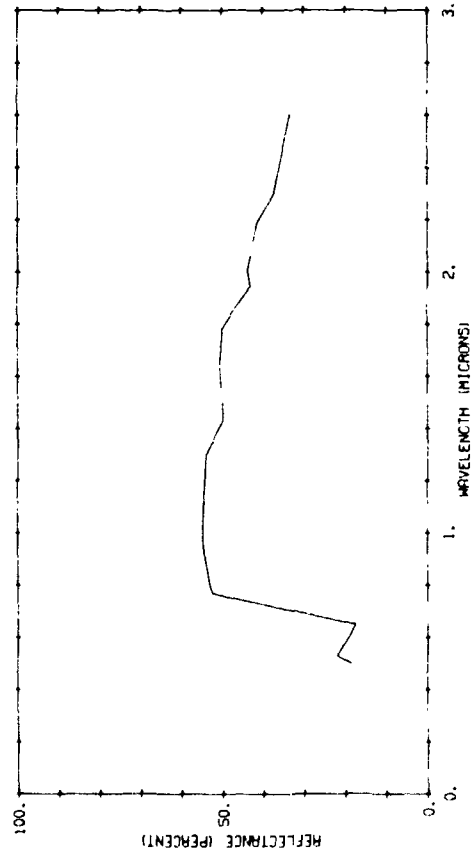
B09007 311

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



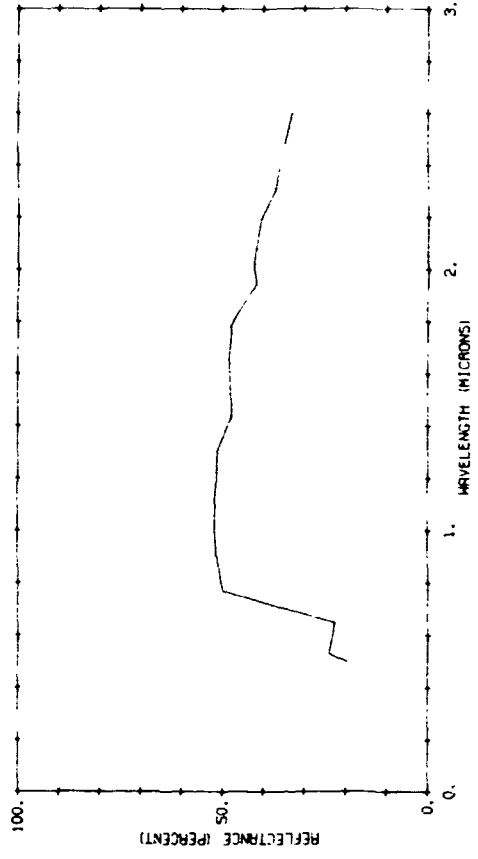
B09007 312

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



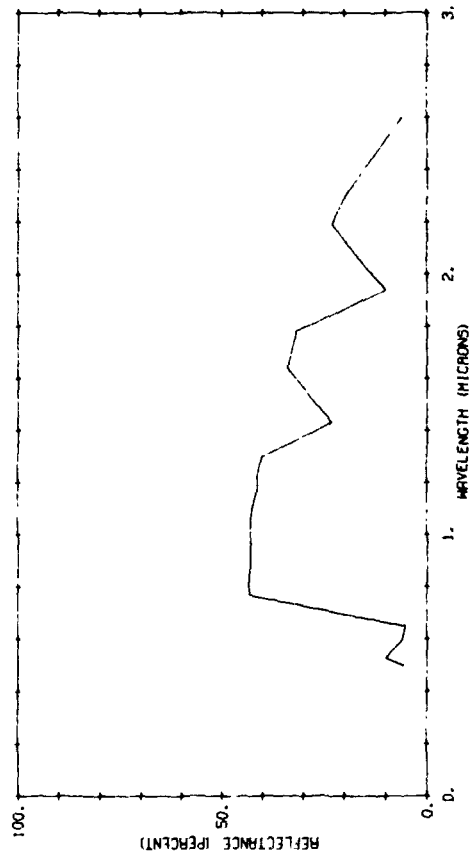
B09007 313

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



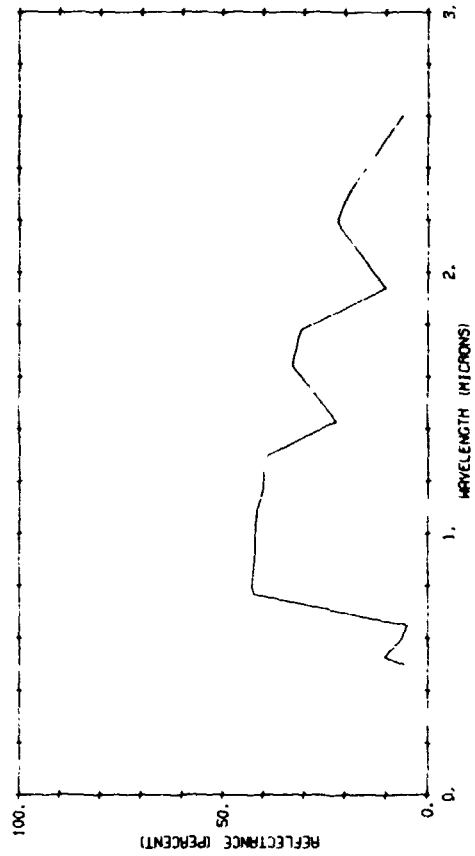
809007 314

TREE 8 LEAF 1 NO WATER SINCE 1 MAY.



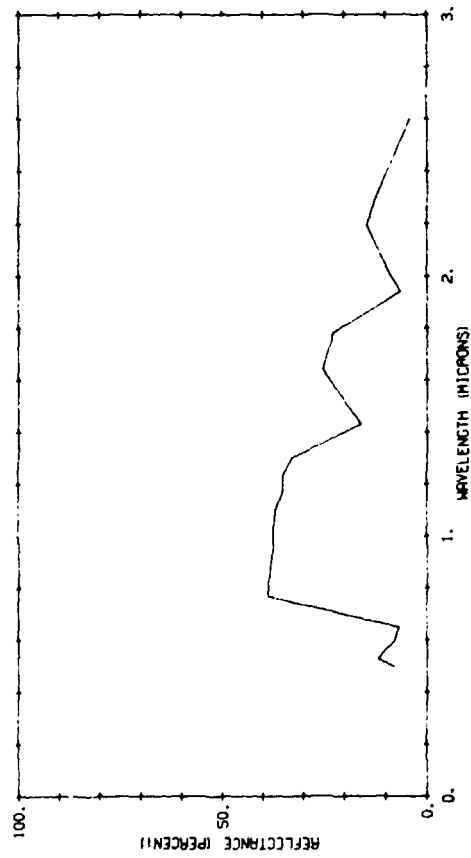
809007 315

TREE 8 LEAF 2 NO WATER SINCE 1 MAY



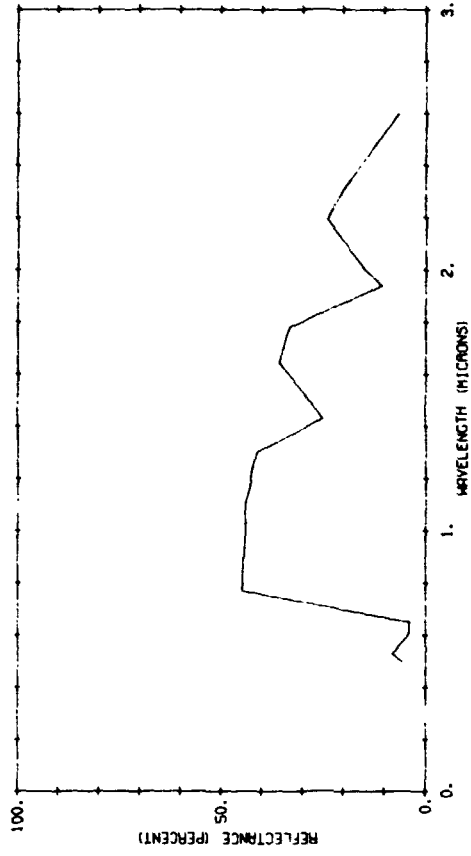
809007 316

TREE 8 LEAF 3 NO WATER SINCE 1 MAY



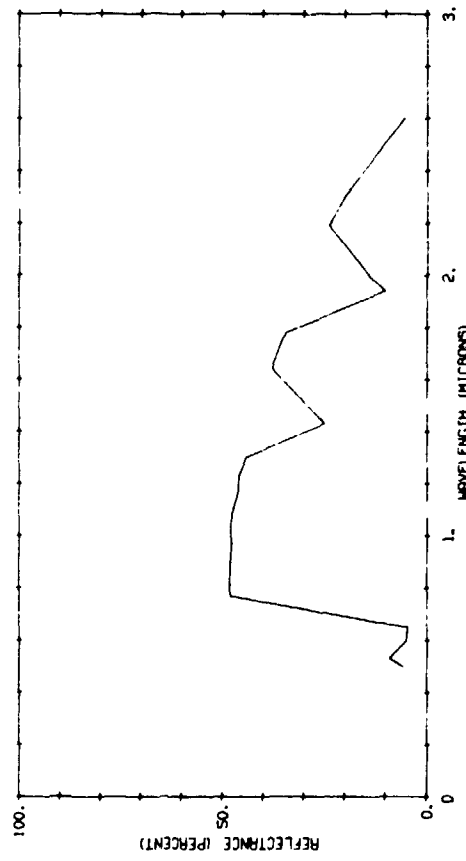
809007 317

TREE 8 LEAF 1 NO WATER SINCE 1 MAY



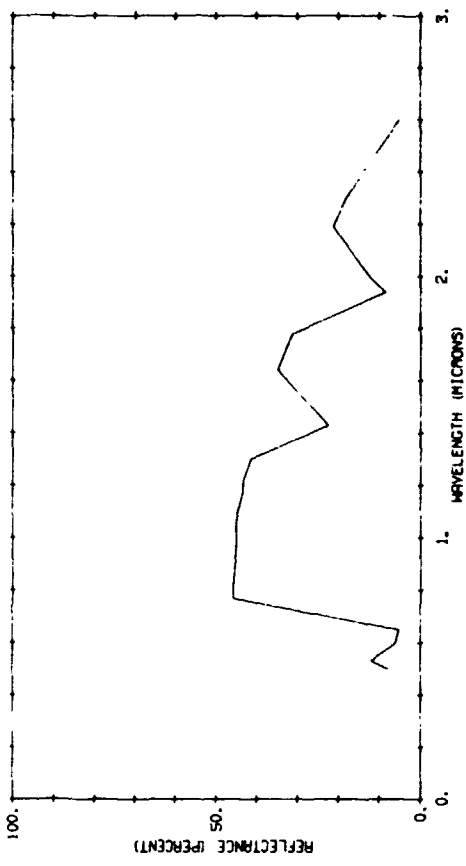
B09007 318

TREE 8, LEAF 2, NO WATER SINCE 1 MAY



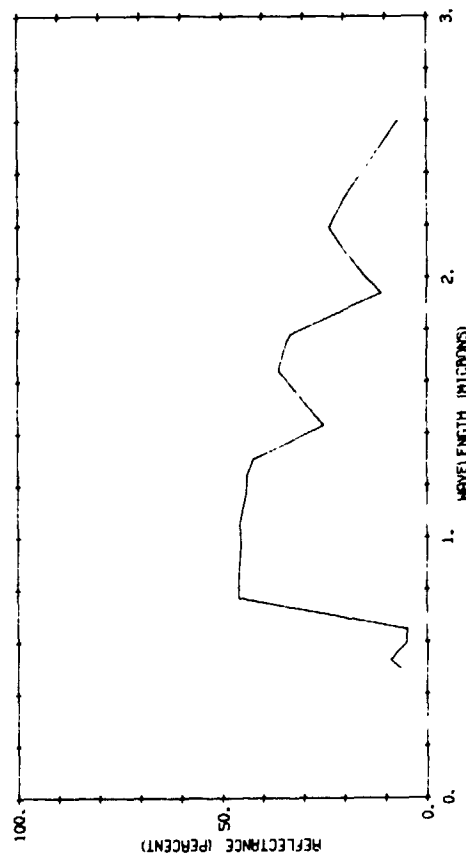
B09007 319

TREE 8, LEAF 3, NO WATER SINCE 1 MAY



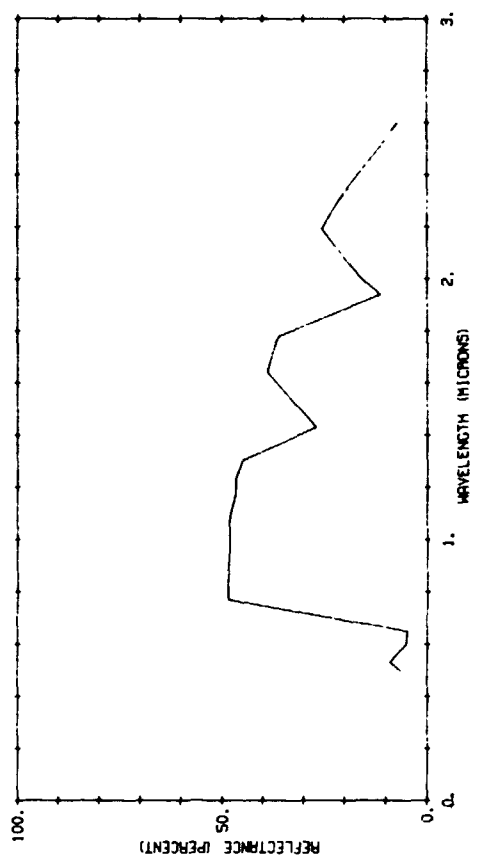
B09007 320

TREE 8, LEAF 1, NO WATER SINCE 1 MAY



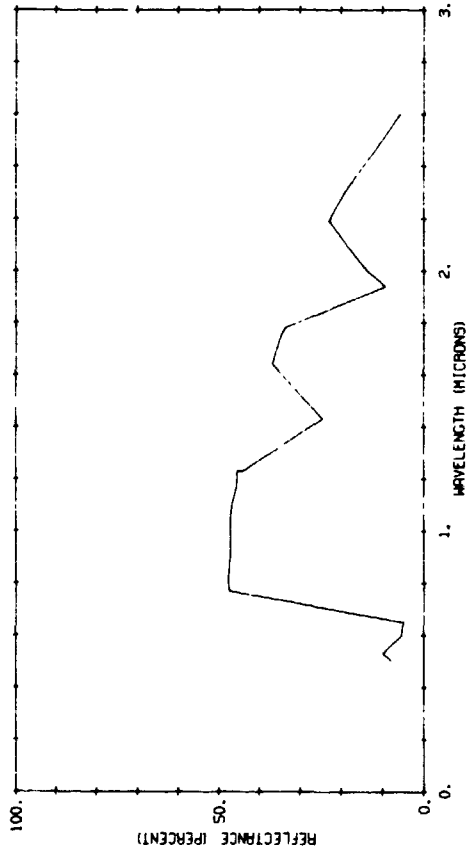
B09007 321

TREE 8, LEAF 2, NO WATER SINCE 1 MAY



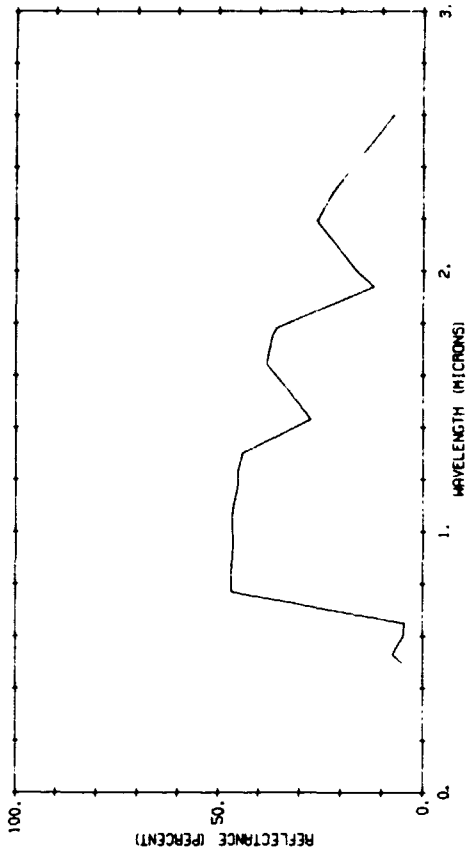
809007 322

TREE 8, LEAF 3 NO WATER SINCE 1 MAY



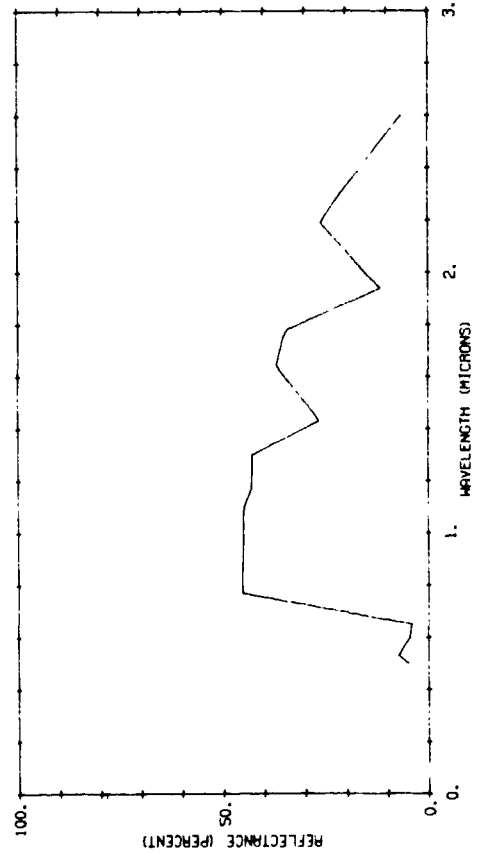
809007 323

TREE 8, LEAF 4 NO WATER SINCE 1 MAY



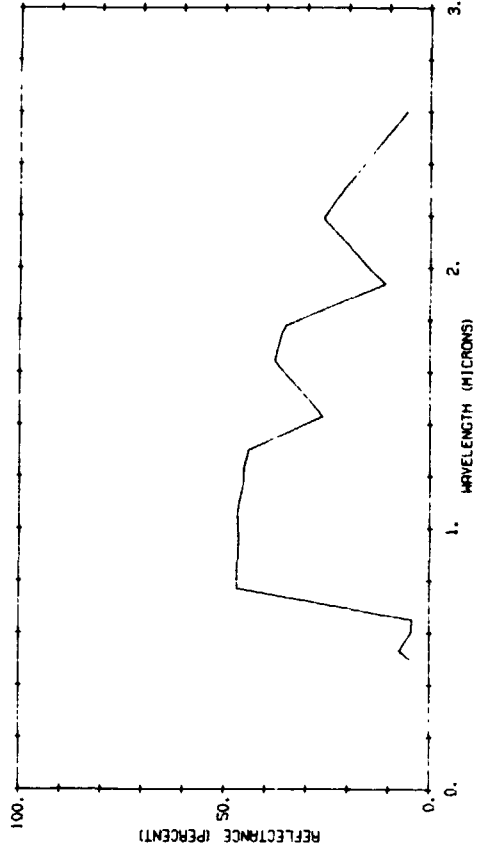
809007 324

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



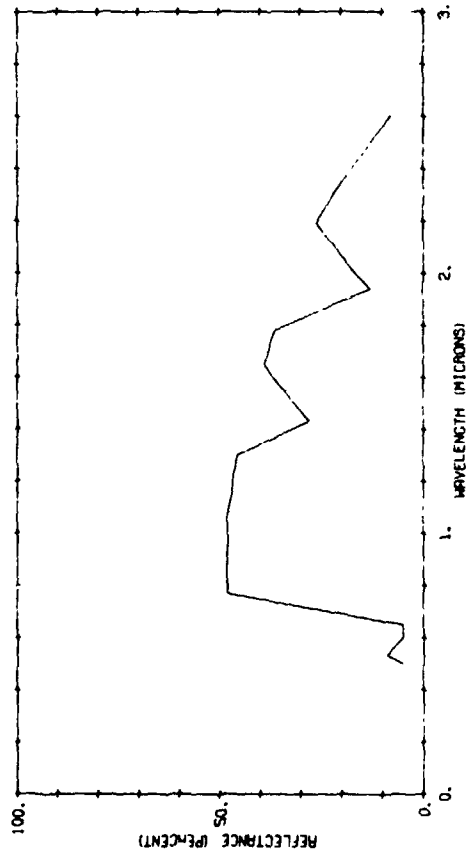
809007 325

TREE 8, LEAF 6 NO WATER SINCE 1 MAY



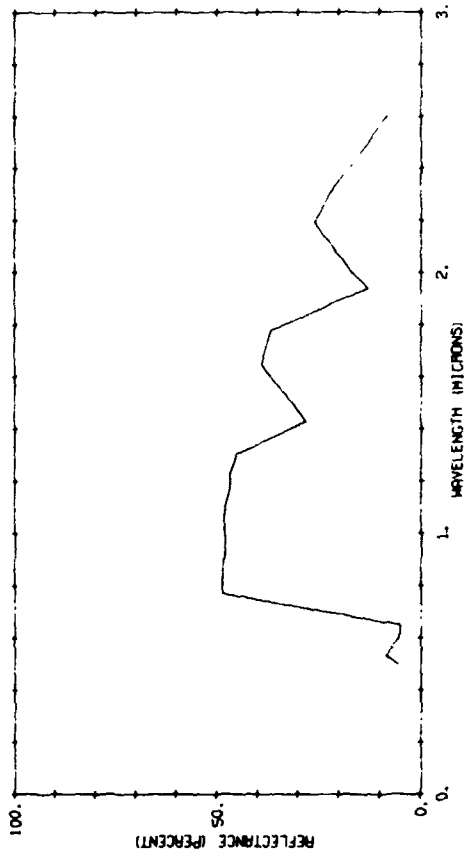
809007 326

TREE 8, LEAF 4. NO WATER SINCE 1 MAY



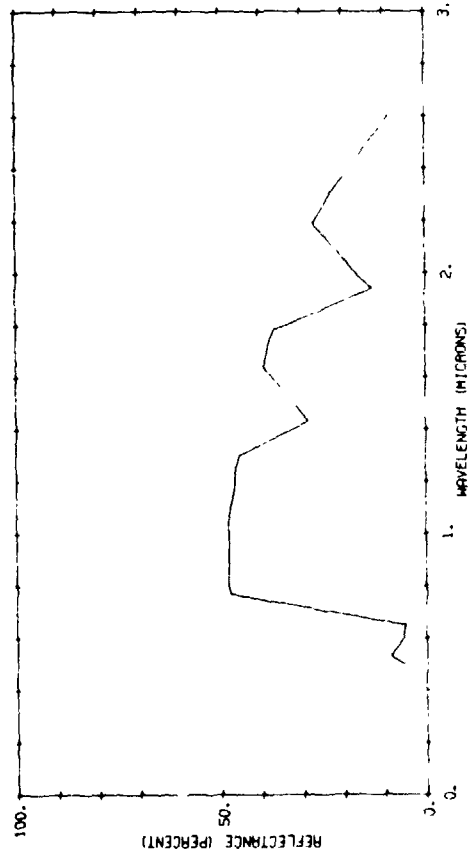
809007 327

TREE 8, LEAF 5. NO WATER SINCE 1 MAY



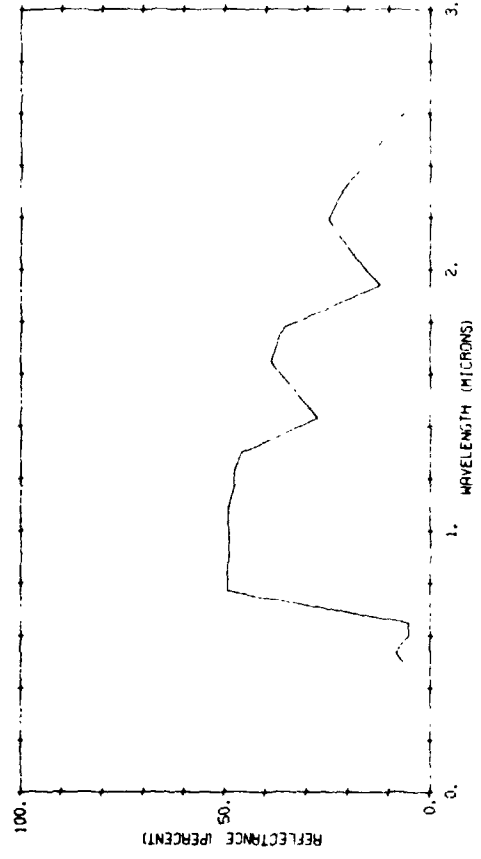
809007 328

TREE 8, LEAF 6. NO WATER SINCE 1 MAY



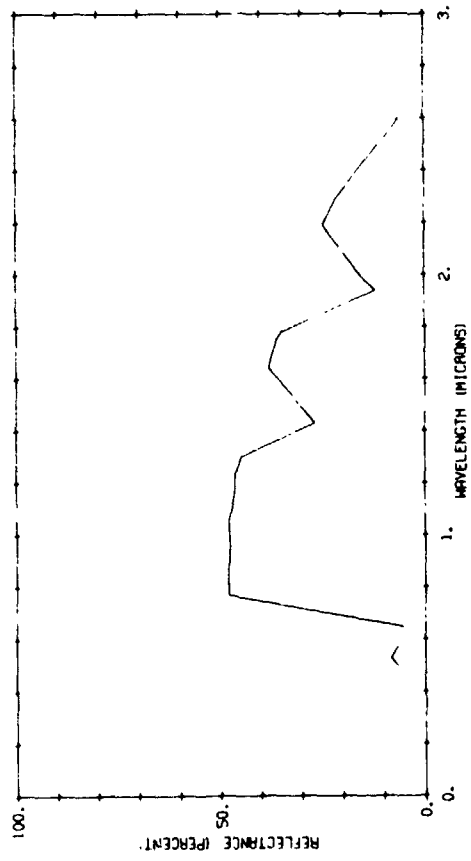
809007 329

TREE 8, LEAF 4. NO WATER SINCE 1 MAY



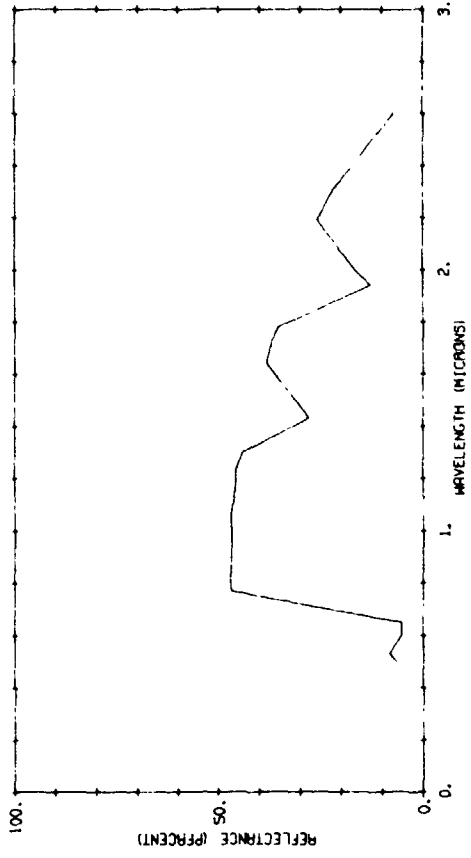
B09007 330

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



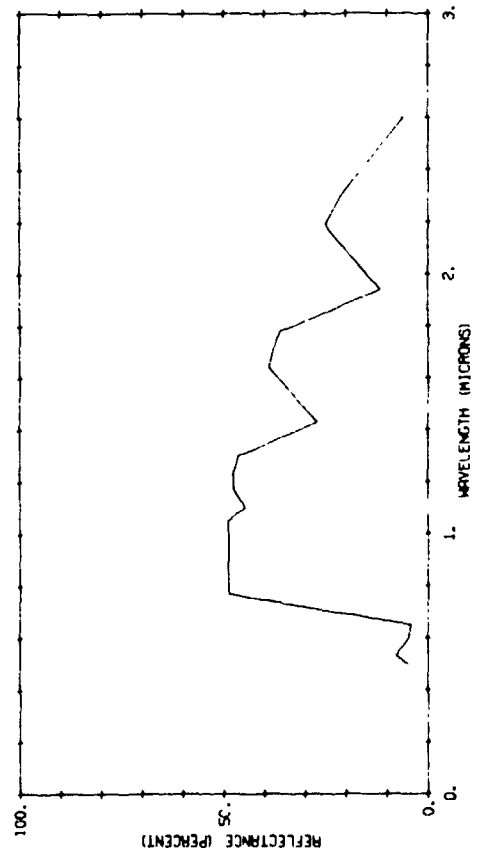
B09007 331

TREE 8, LEAF 6 NO WATER SINCE 1 MAY



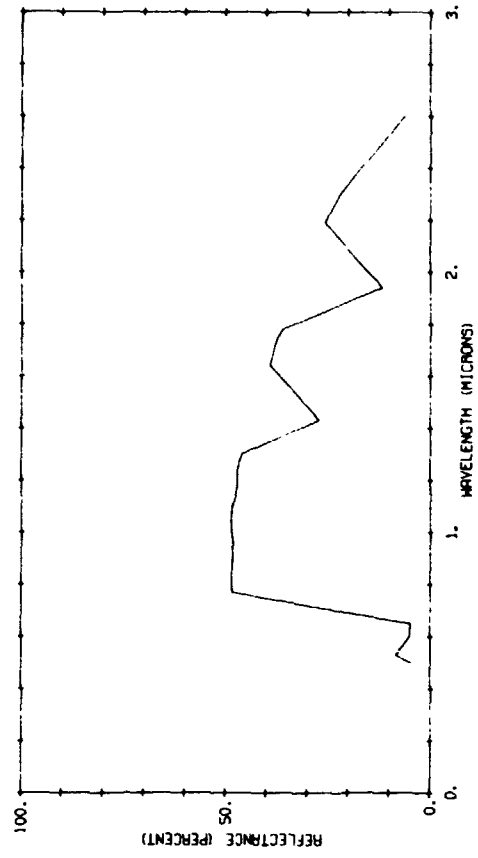
B09007 332

TREE 8, LEAF 4 NO WATER SINCE 1 MAY



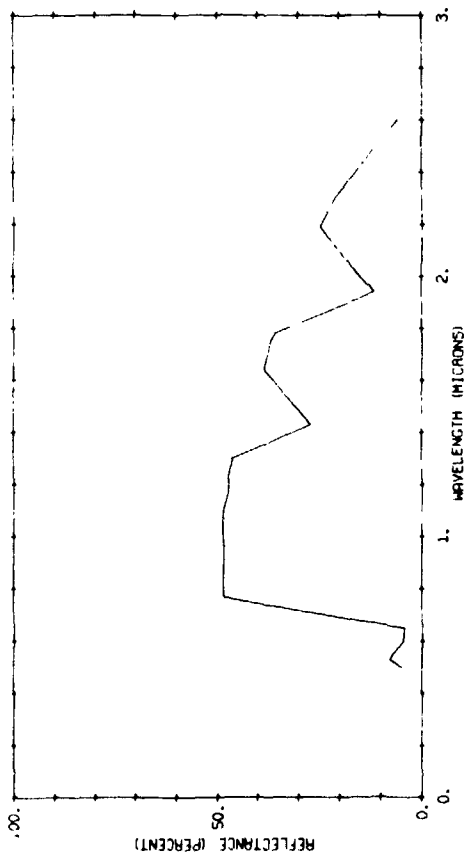
B09007 333

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



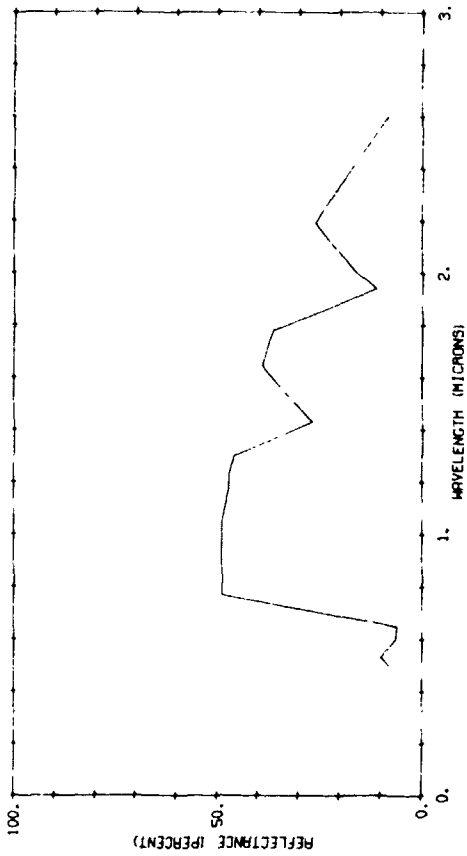
809007 334

TREE 6, LEAF 5 NO WATER SINCE 1 MAY



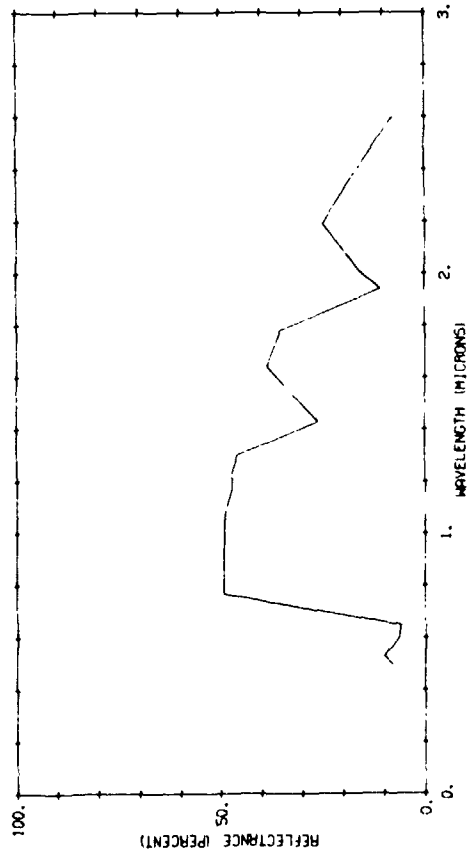
809007 335

TREE 6, LEAF 4 NO WATER SINCE 1 MAY



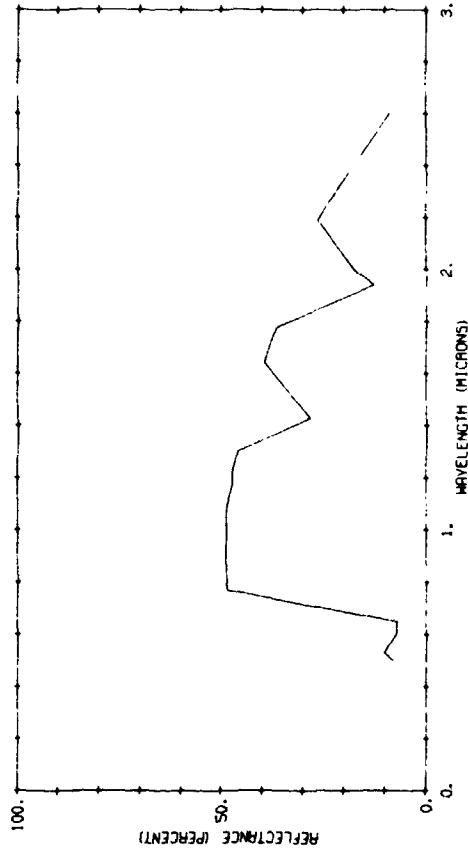
809007 336

TREE 6, LEAF 5 NO WATER SINCE 1 MAY



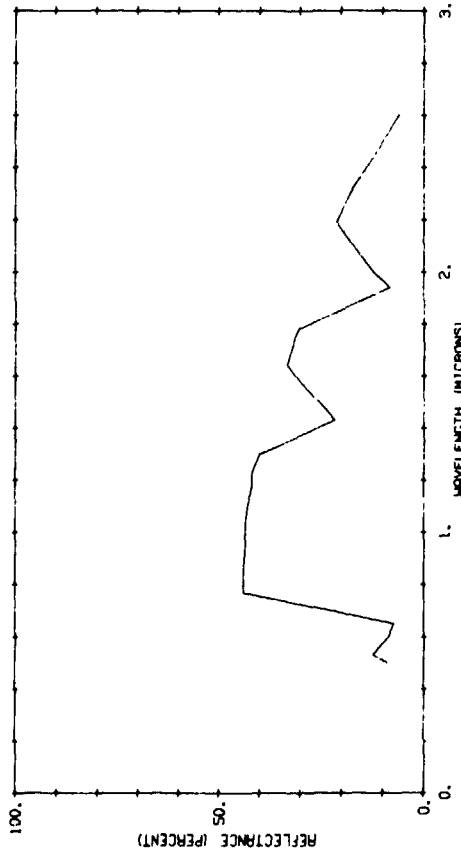
809007 337

TREE 6, LEAF 6 NO WATER SINCE 1 MAY



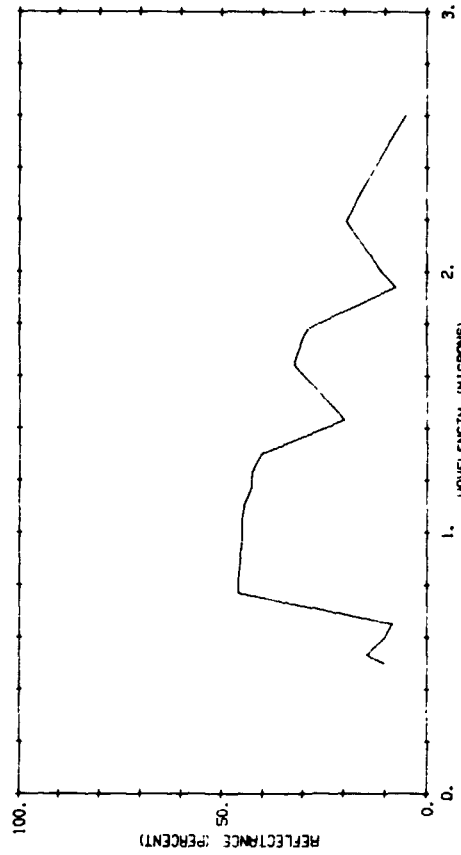
B03007 338

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



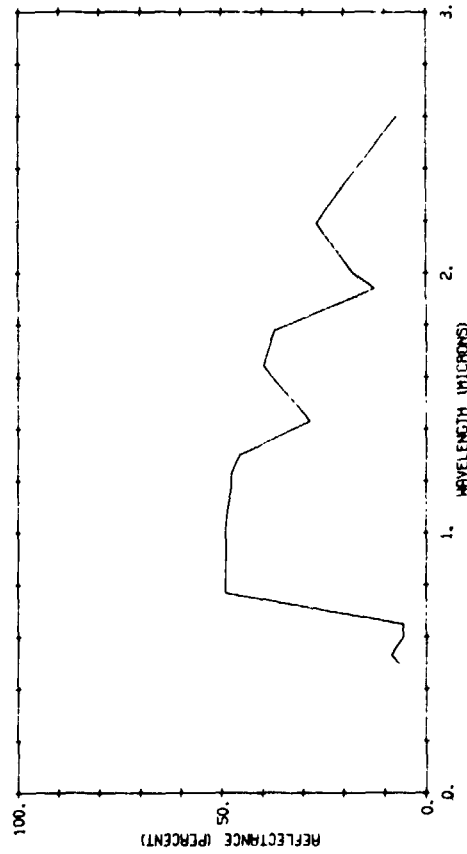
B09007 339

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



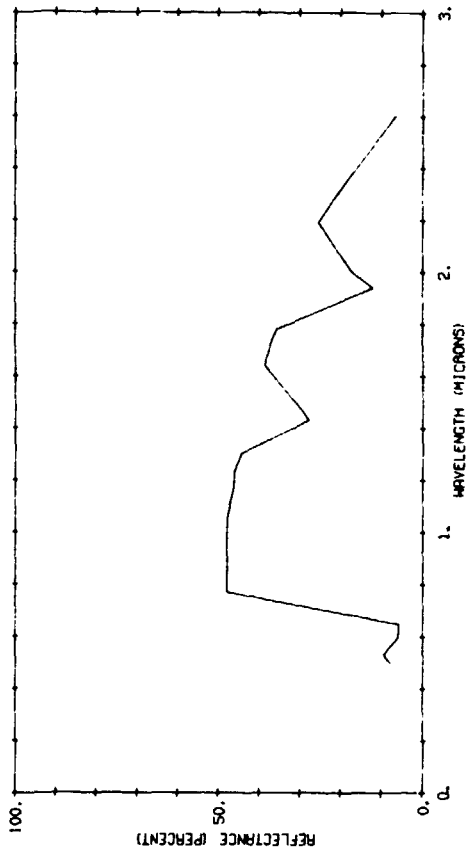
B09007 340

TREE 8, LEAF 4 NO WATER SINCE 1 MAY



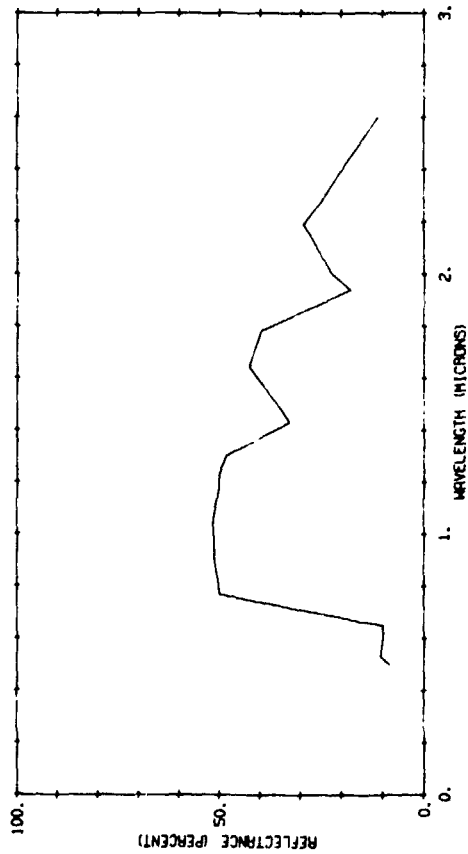
B09007 341

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



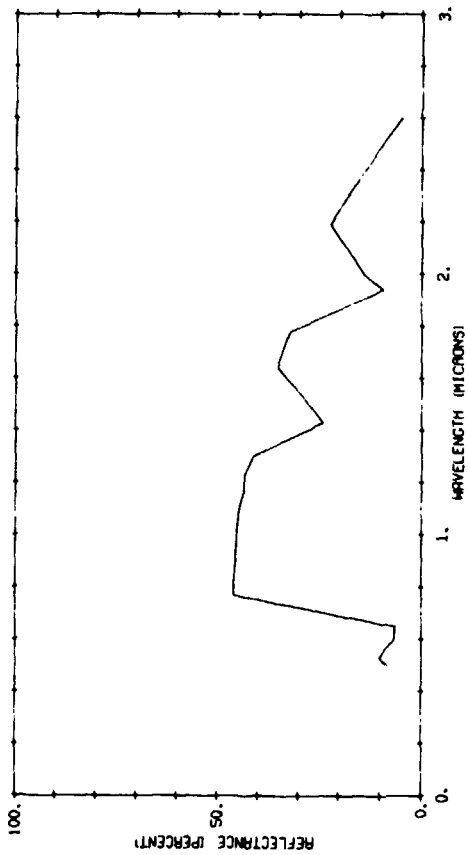
B09007 342

TREE 8, LEAF 6 NO WATER SINCE 1 MAY



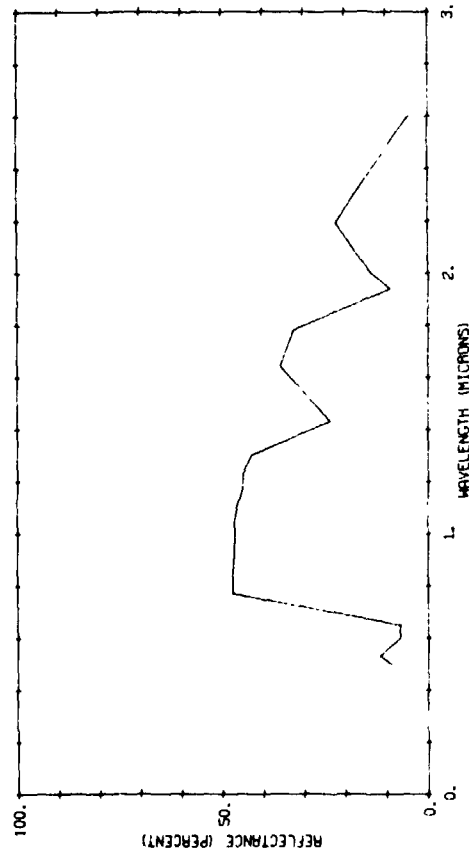
B09007 343

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



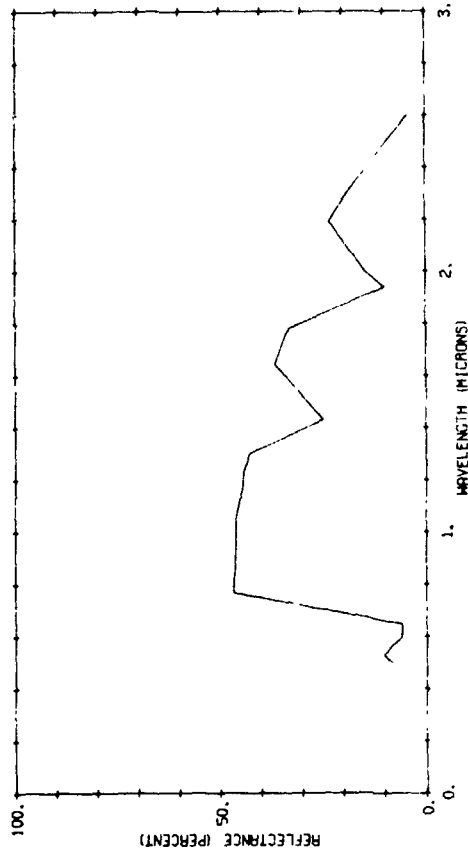
B09007 344

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



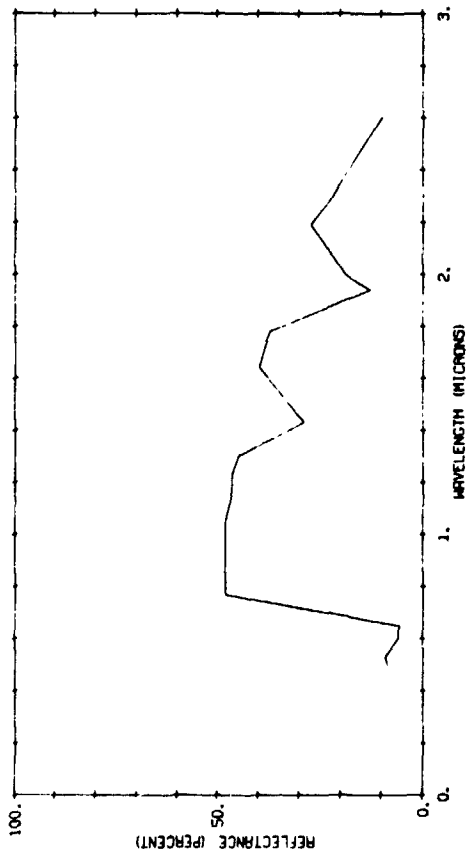
B09007 345

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



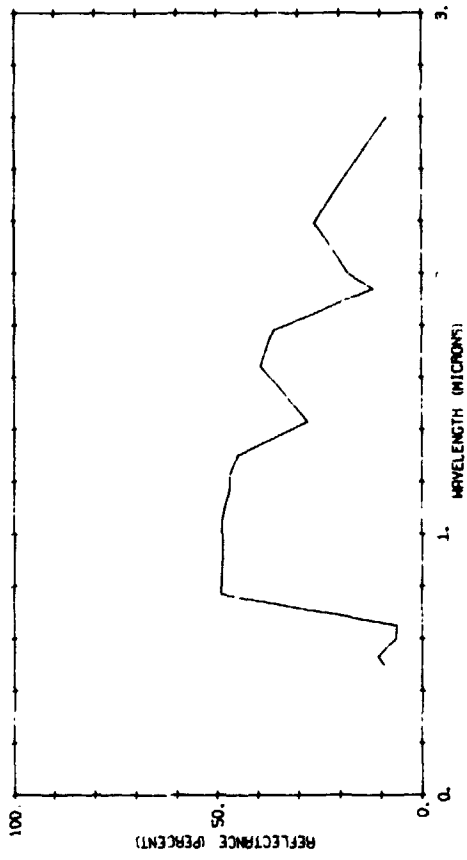
809007 346

TREE 8, LEAF 4 NO WATER SINCE 1 MAY



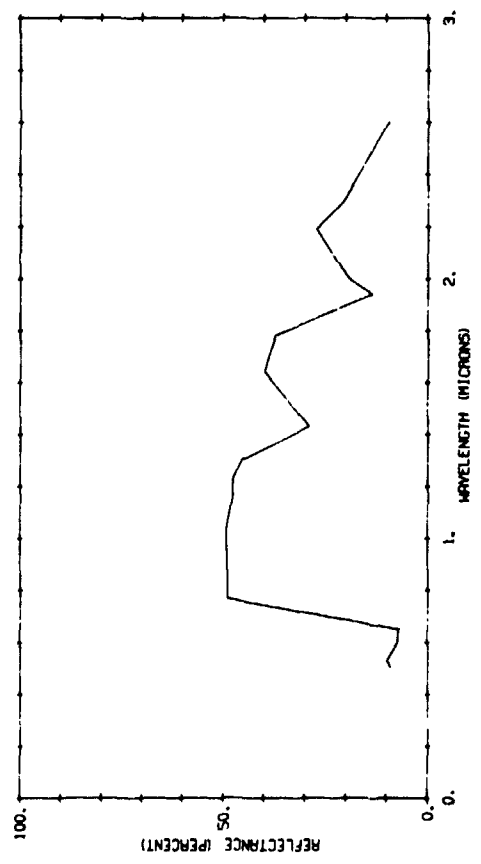
809007 347

TREE 8, LEAF 5 NO WATER SINCE 1 MAY



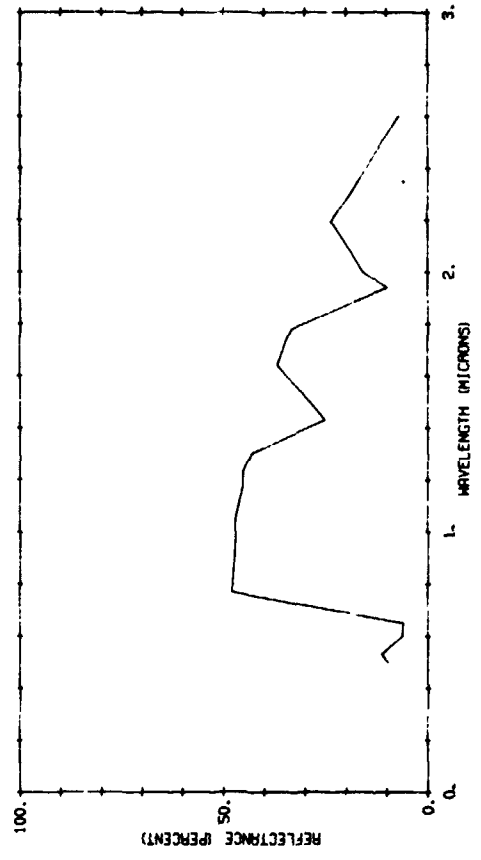
809007 348

TREE 8, LEAF 6 NO WATER SINCE 1 MAY



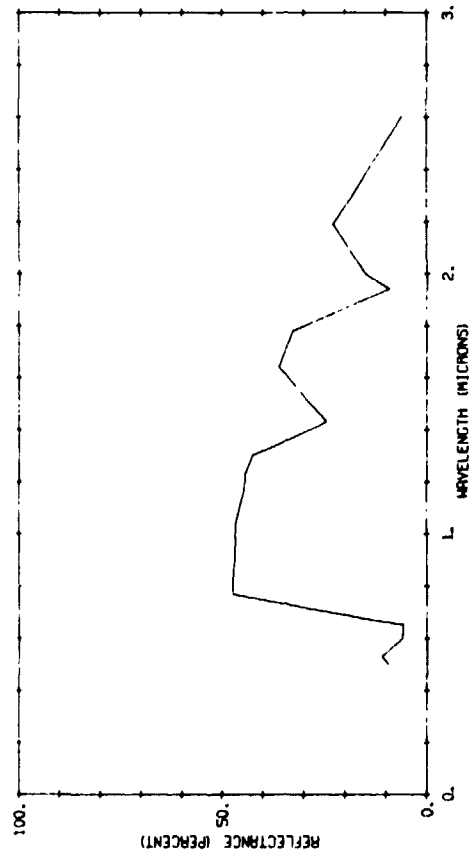
809007 349

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



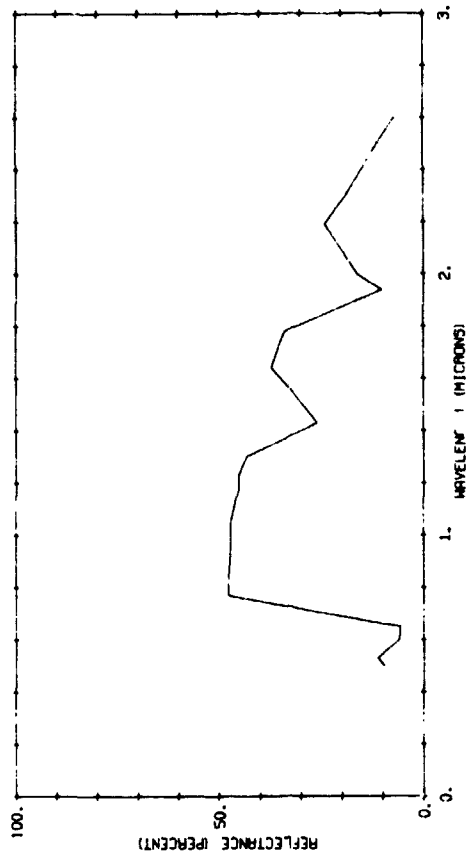
B09007 350

TREE 6, LEAF 8 NO WATER SINCE 1 MAY LEAF FROM SECOND FLUSH OF SEASON



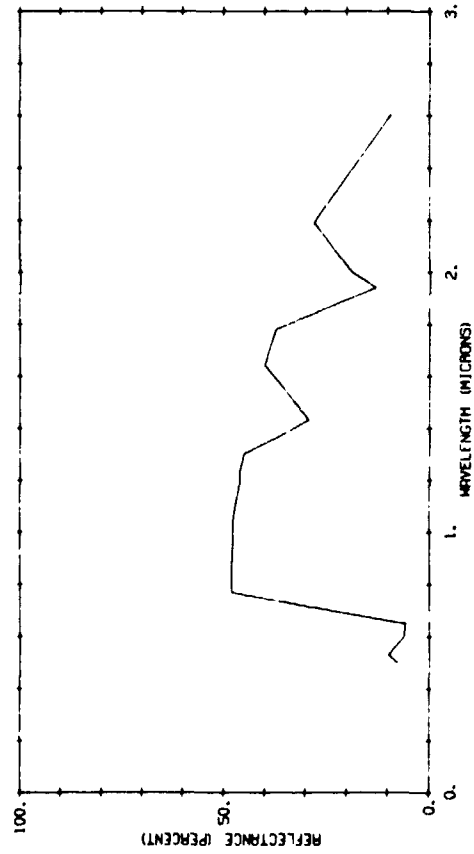
B09007 351

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



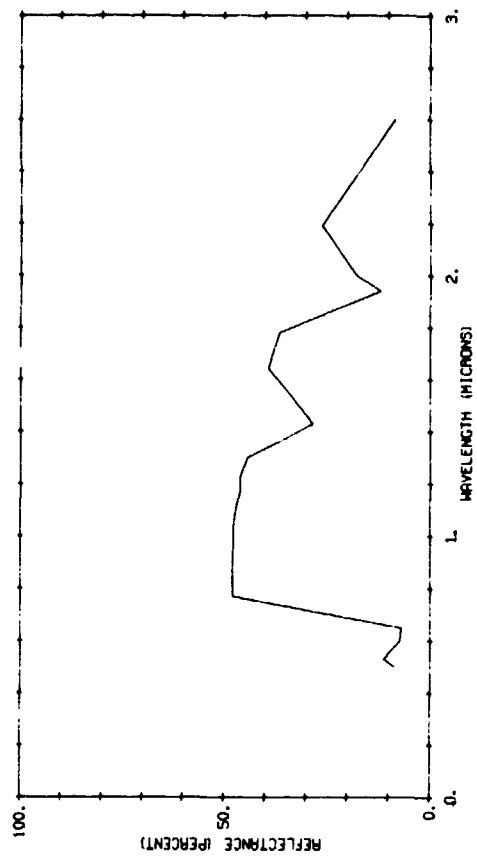
B09007 352

TREE 6, LEAF 4 NO WATER SINCE 1 MAY



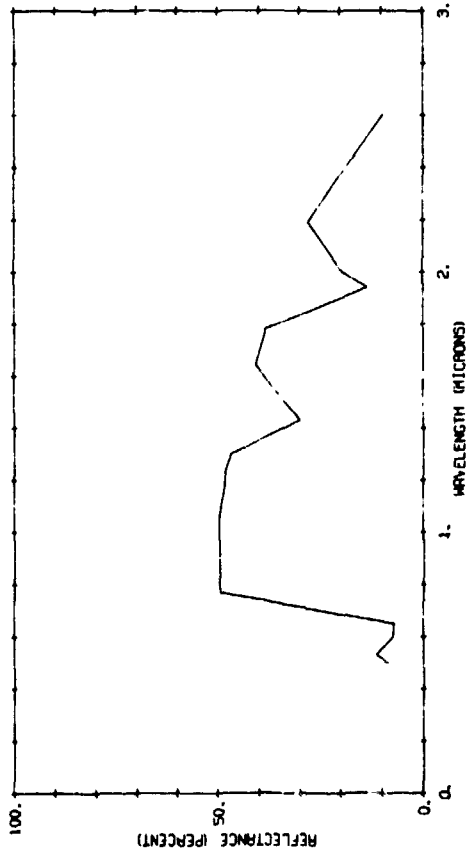
B09007 353

TREE 6, LEAF 5 NO WATER SINCE 1 MAY



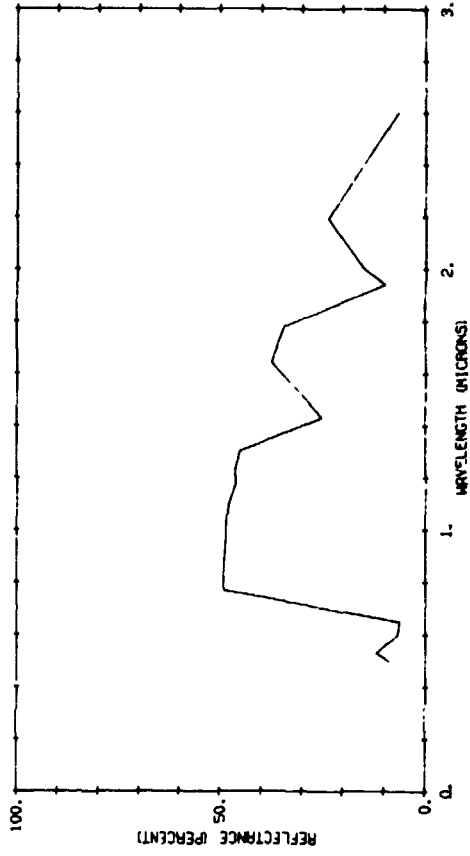
B09007 354

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



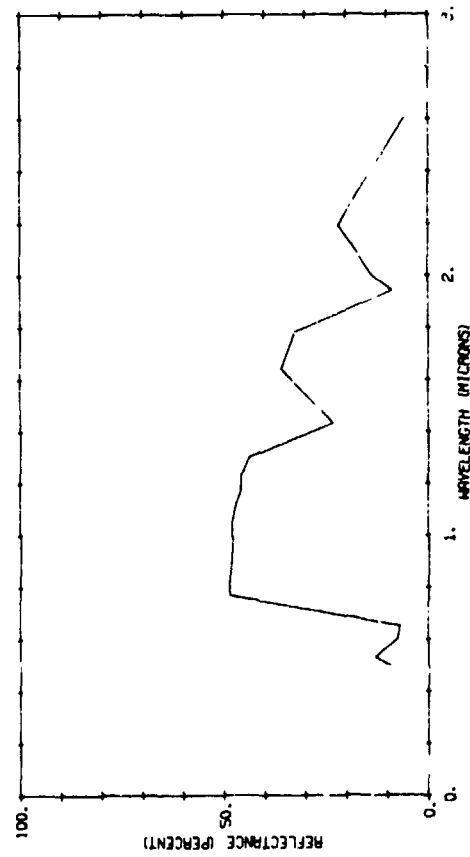
B09007 355

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



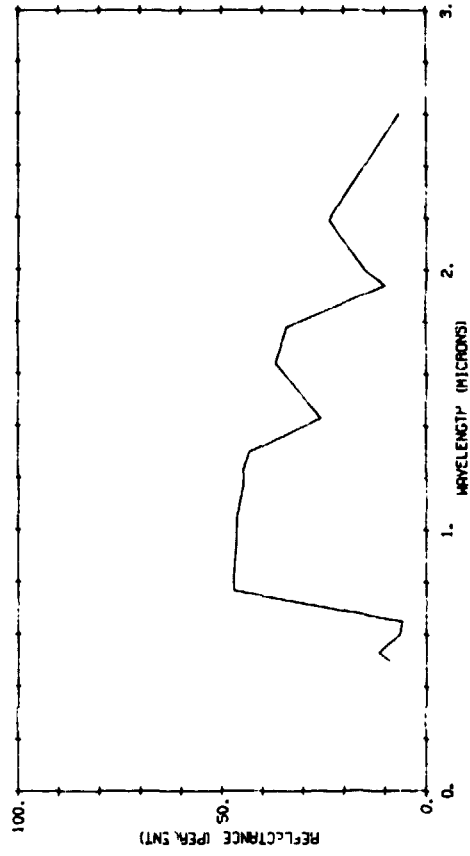
B09007 356

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



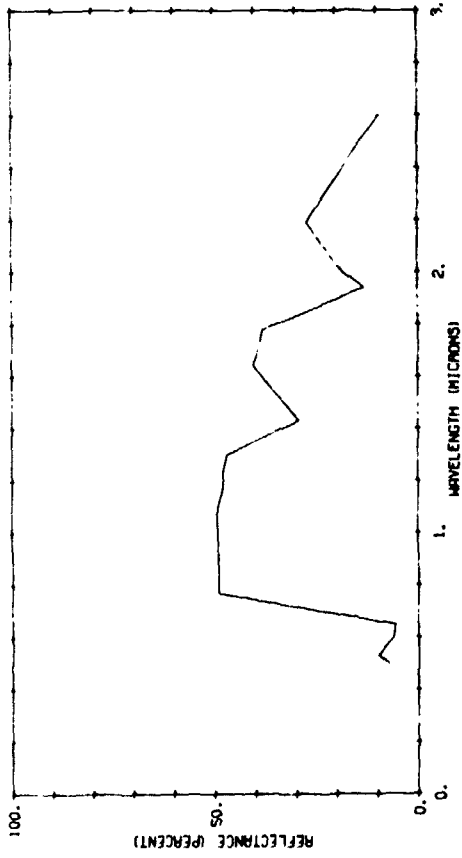
B09007 357

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



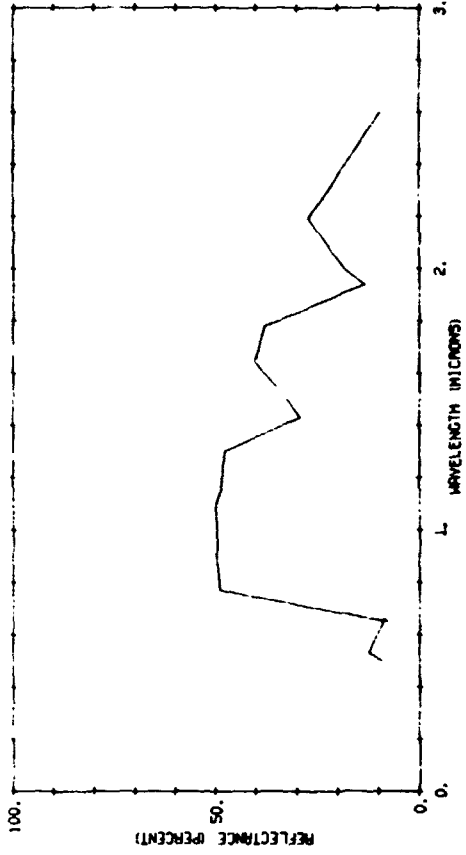
809007 358

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



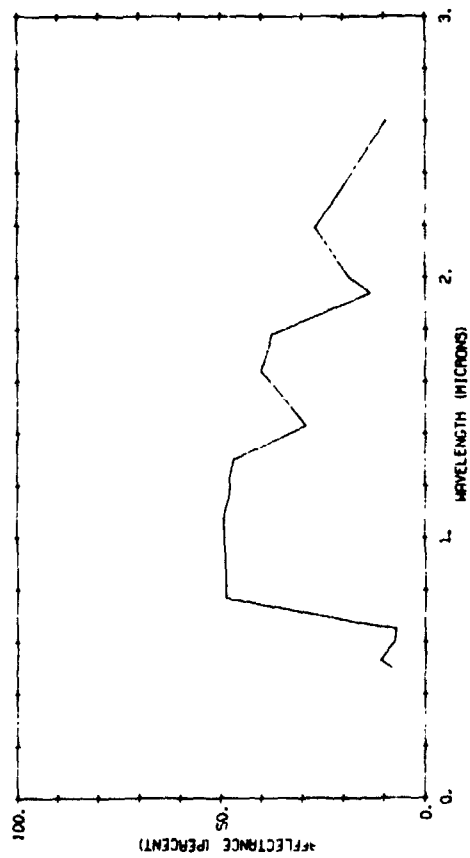
809007 359

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



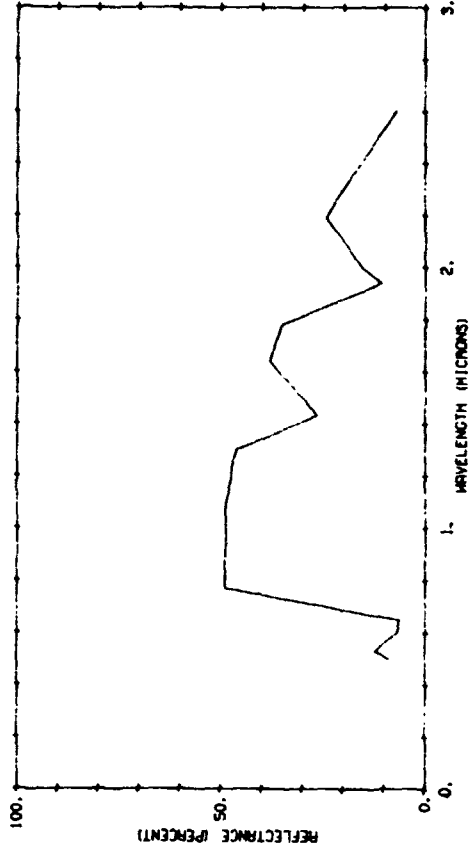
809007 360

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



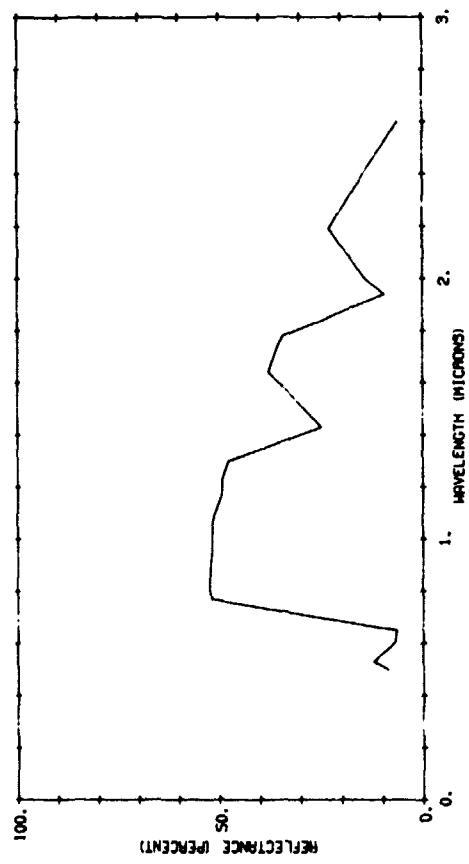
809007 361

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



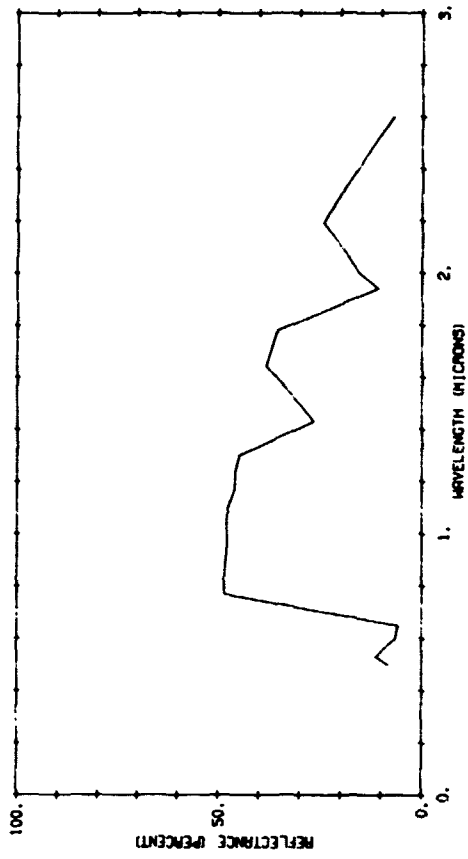
B09007 362

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



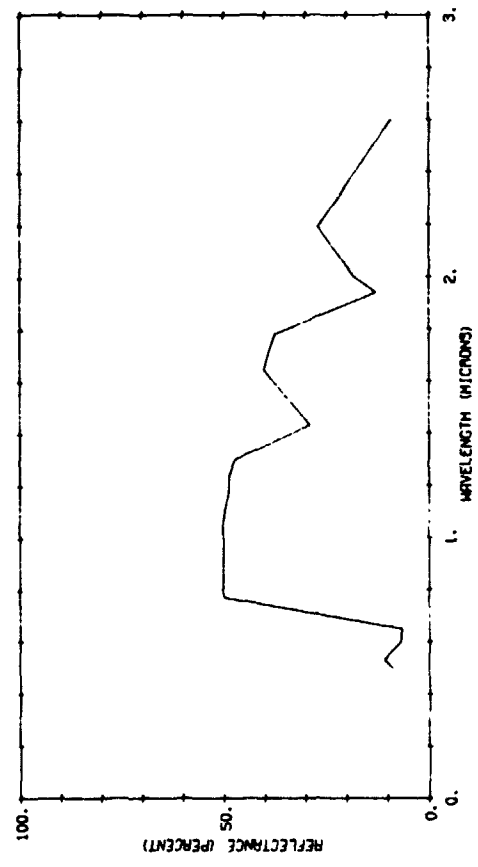
B09007 363

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



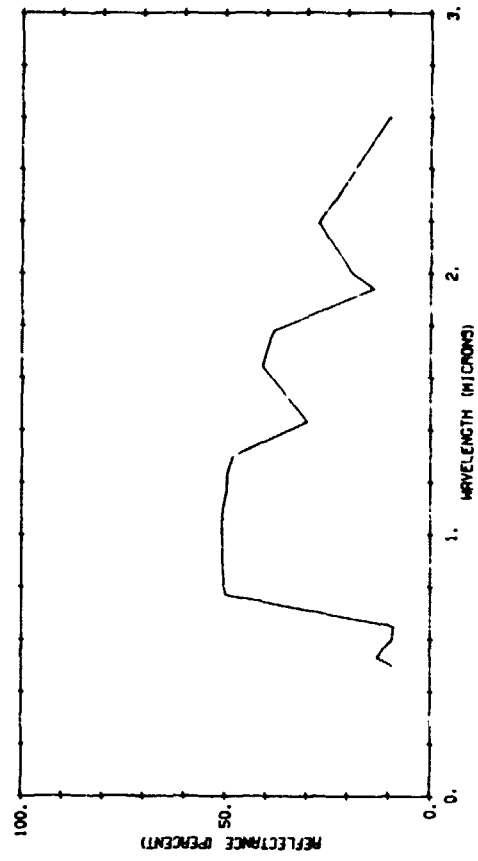
B09007 364

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



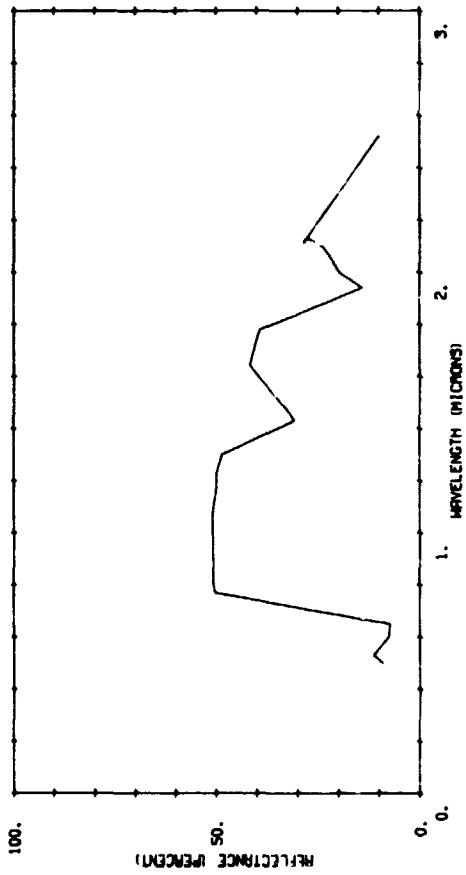
B09007 365

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



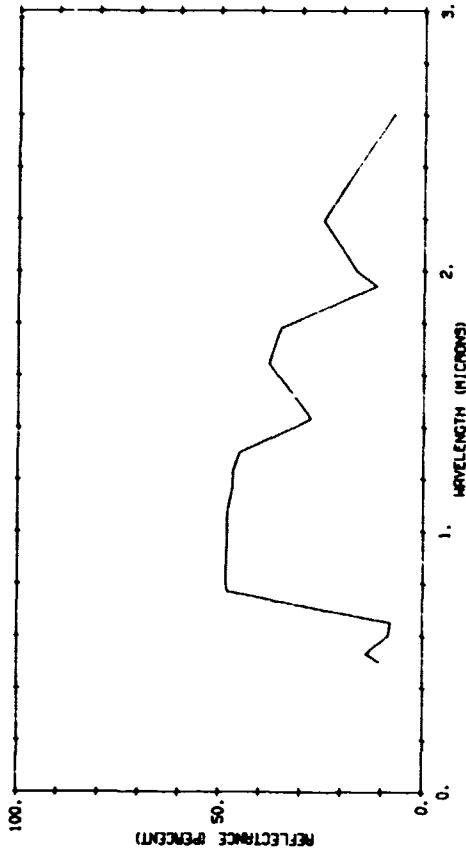
B09007 366

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



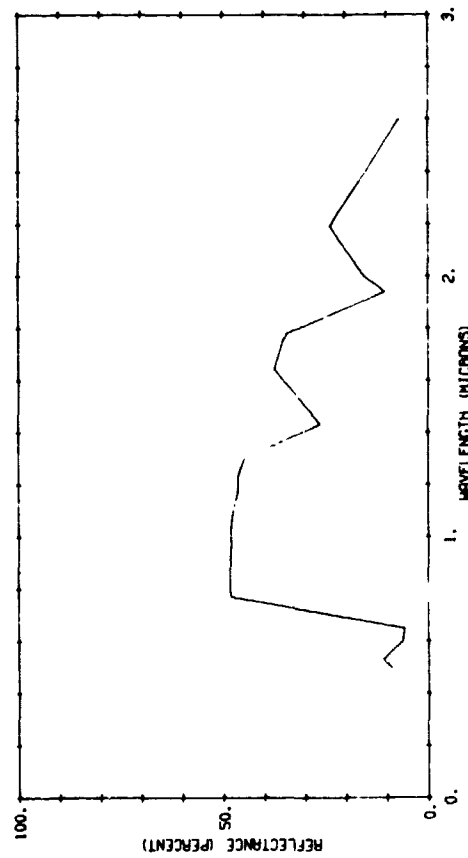
B09007 367

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



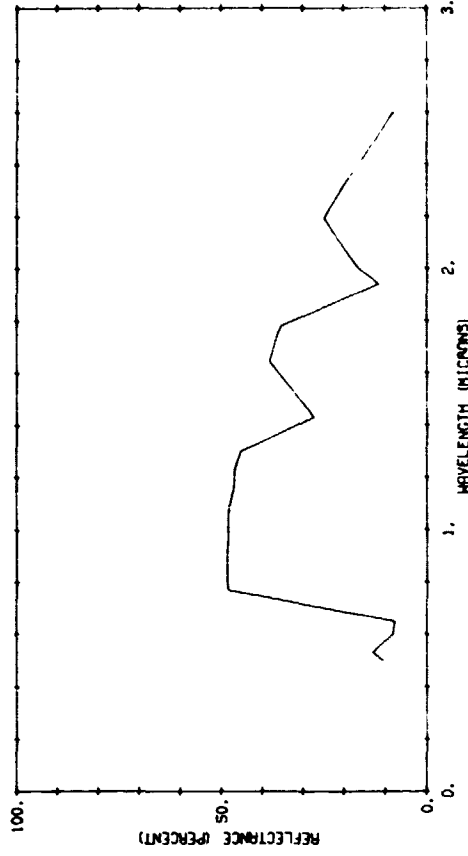
B09007 368

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



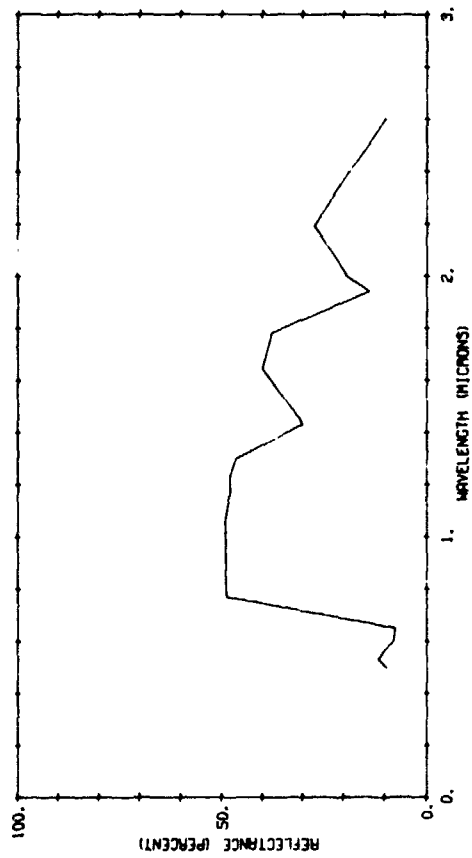
B09007 369

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



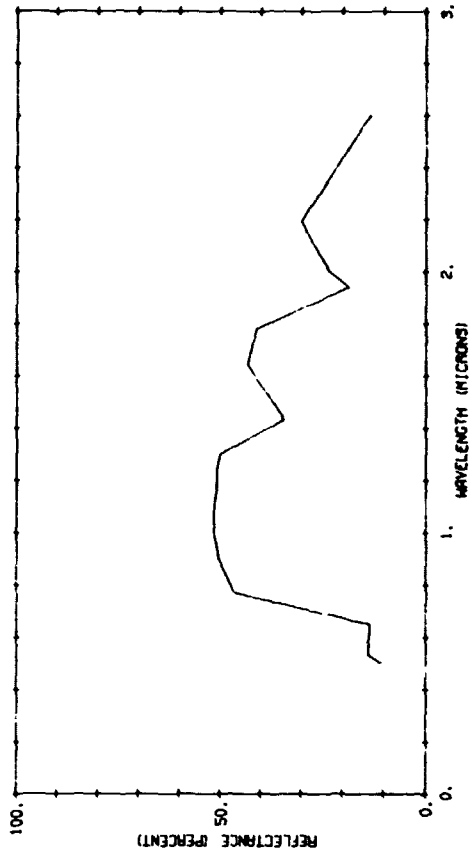
809007 370

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



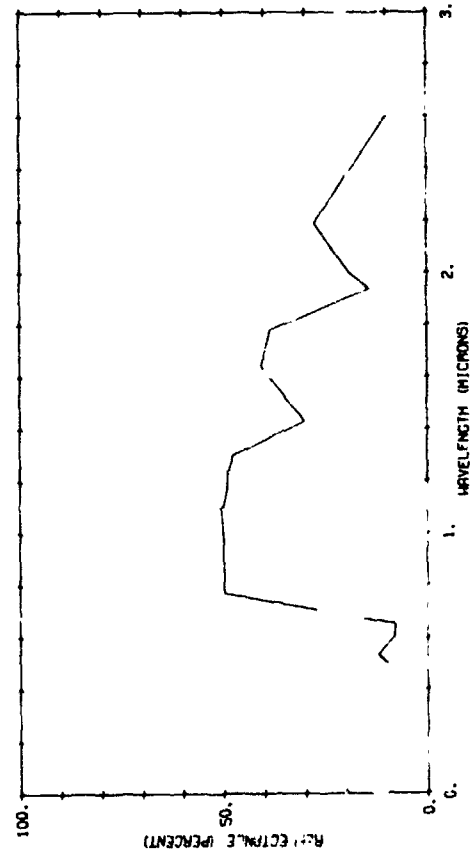
809007 371

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



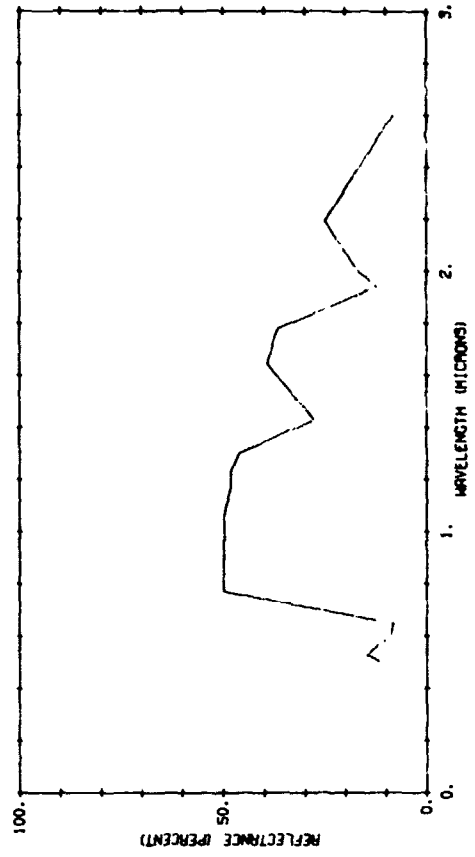
809007 372

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



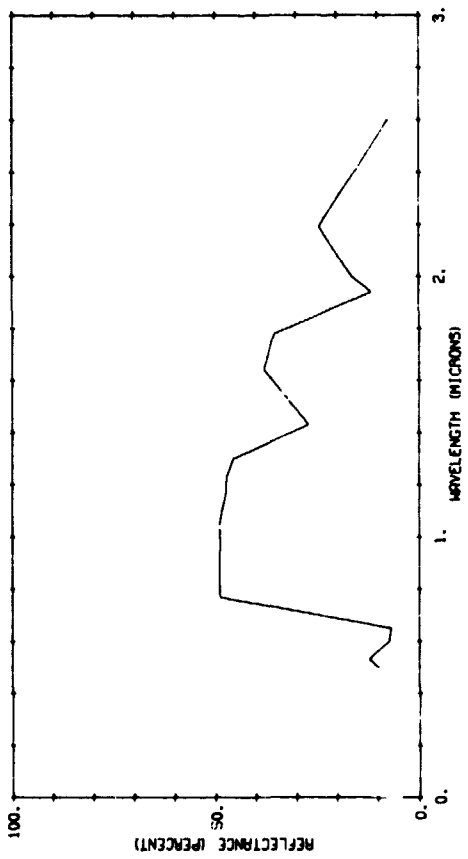
809007 373

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



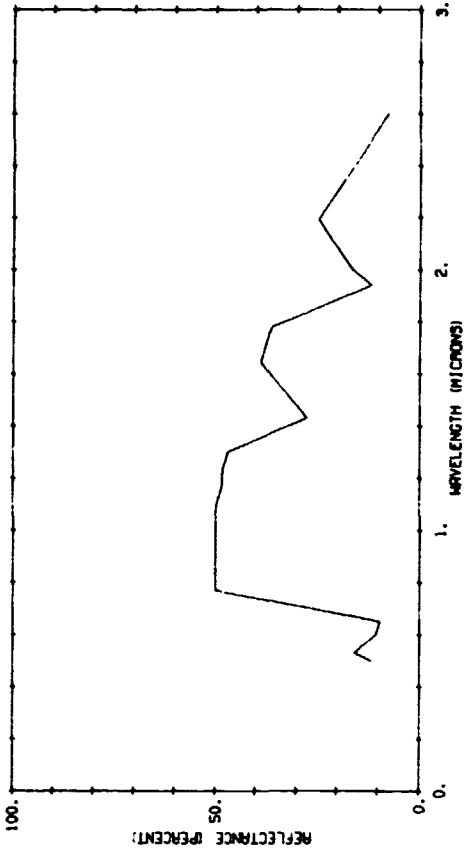
B09007 374

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



B09007 375

TREE 8, LEAF 8 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

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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	1
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

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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

61K4-98

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

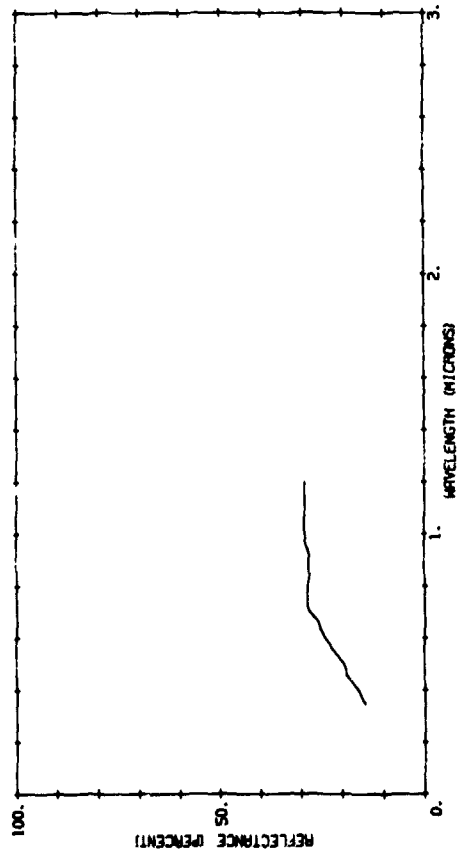
61K4-99

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% SiO₂)

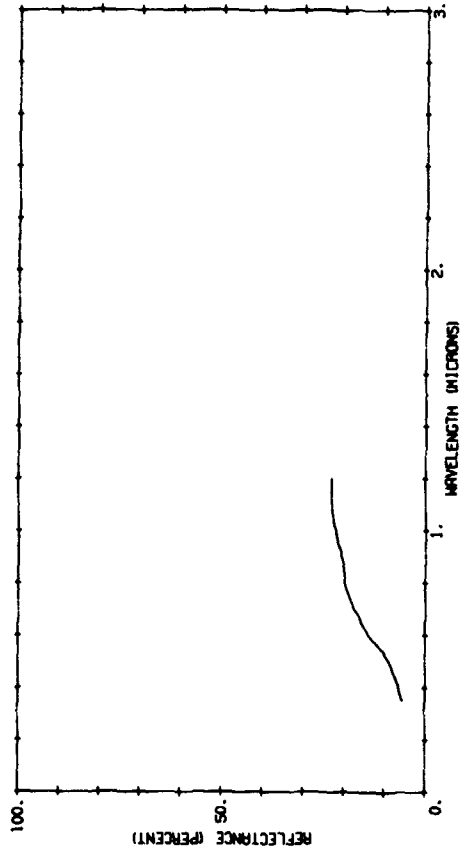
R09025 101

RHYODACITE (2A3) PISGAH SAMPLE FRESH



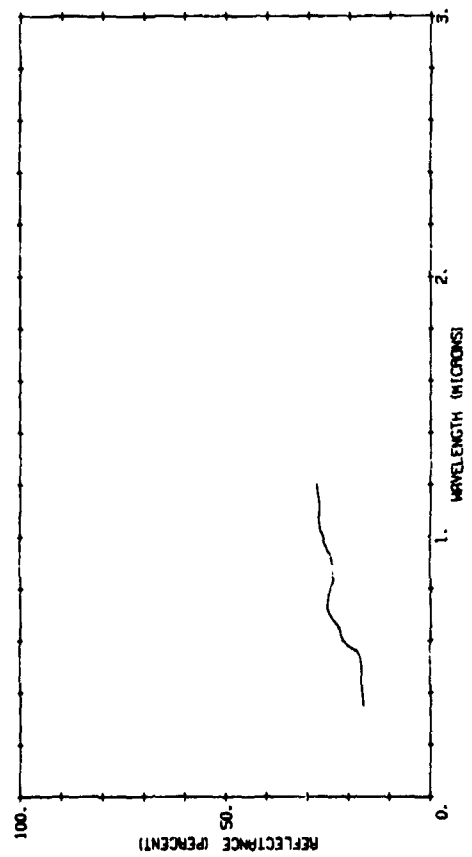
R09025 201

RHYODACITE (2A3) PISGAH SAMPLE WEATHERED



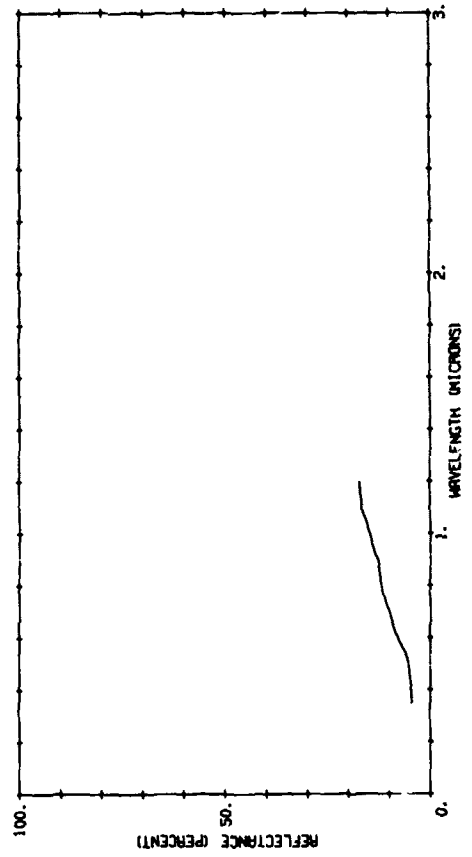
R09031 101

RHYODACITE (2A8) PISGAH SAMPLE FRESH



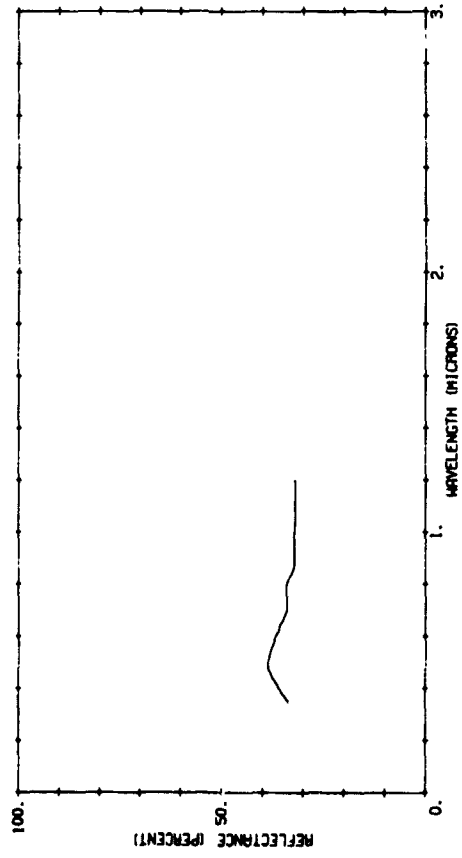
R09031 201

RHYODACITE (2A8) PISGAH SAMPLE WEATHERED



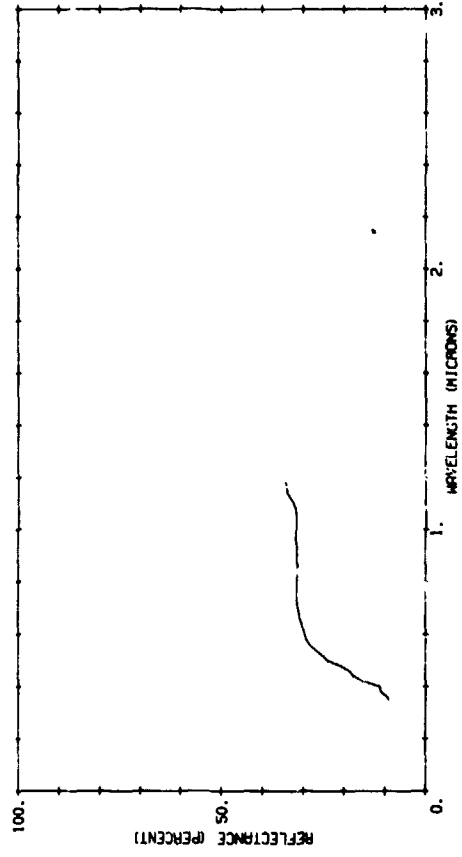
A09027 101

DACITE PORPHYRY (2A4) PISGAH SAMPLE FRESH



A09027 201

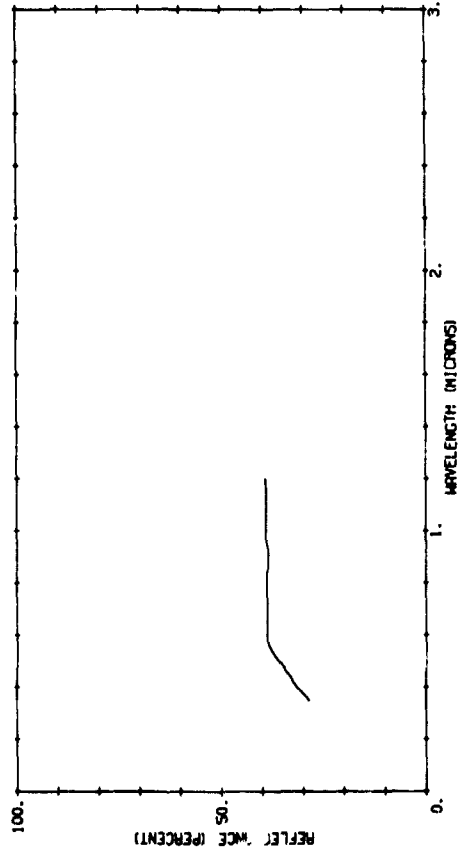
DACITE PORPHYRY (2A4) PISGAH SAMPLE WEATHERED



101 - 2

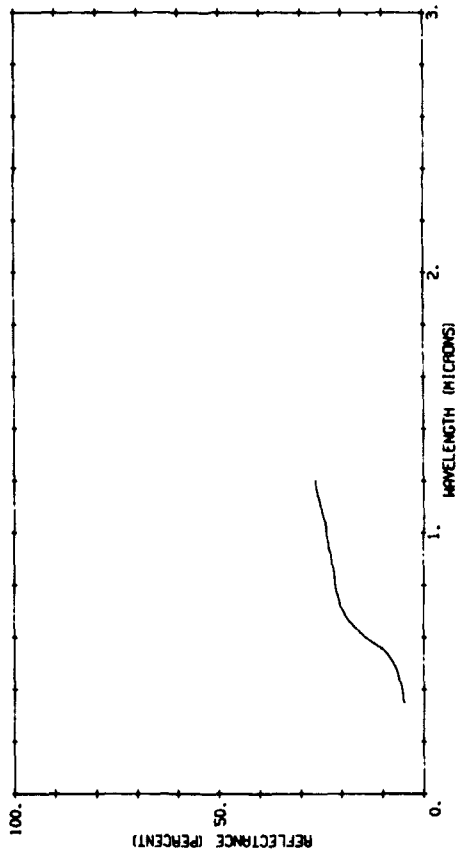
A09028 101

DACITE PORPHYRY (2A5) PISGAH SAMPLE FRESH



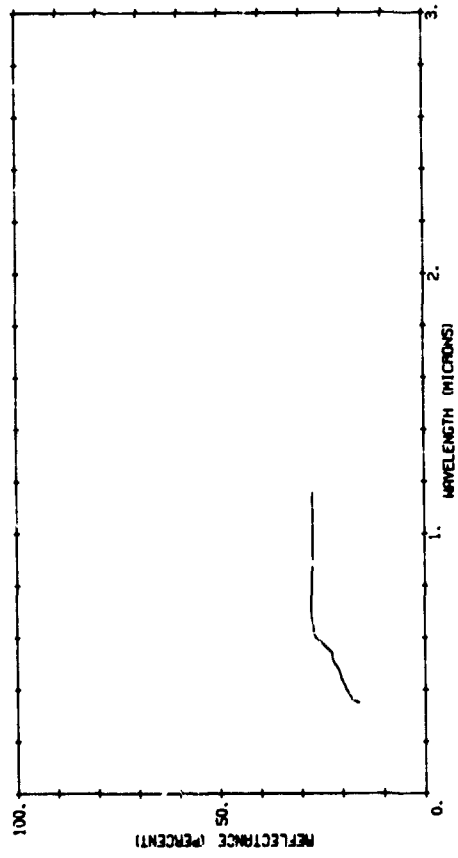
A09028 201

DACITE PORPHYRY (2A5) PISGAH SAMPLE WEATHERED



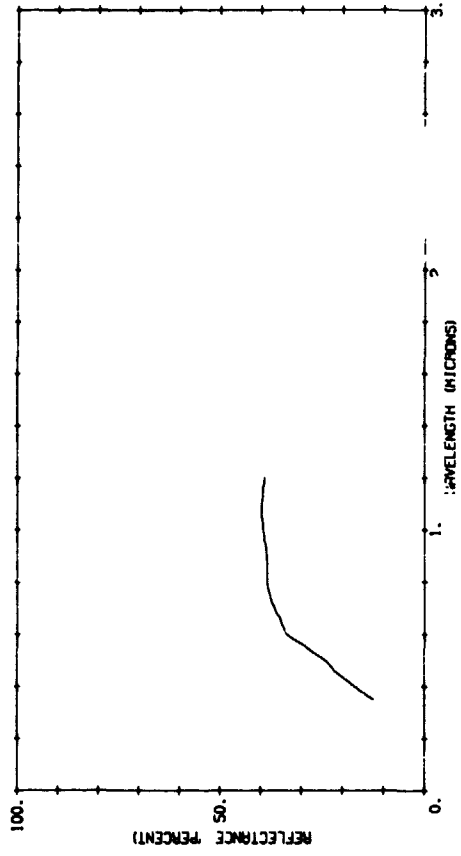
A09036 101

TUFF (2B41) NORTH OF CINDER CONE, PISGAH CRATER FRESH.



A09036 201

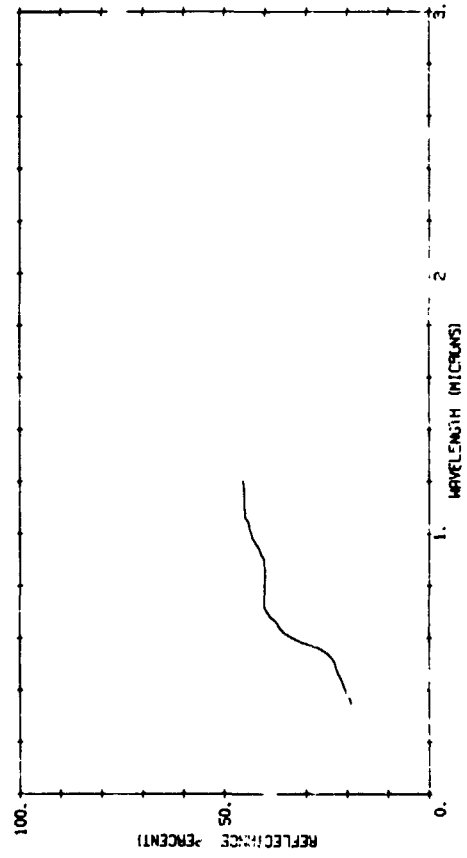
TUFF (2B41) NORTH OF CINDER CONE, PISGAH CRATER WEATHERED.



101 - 3

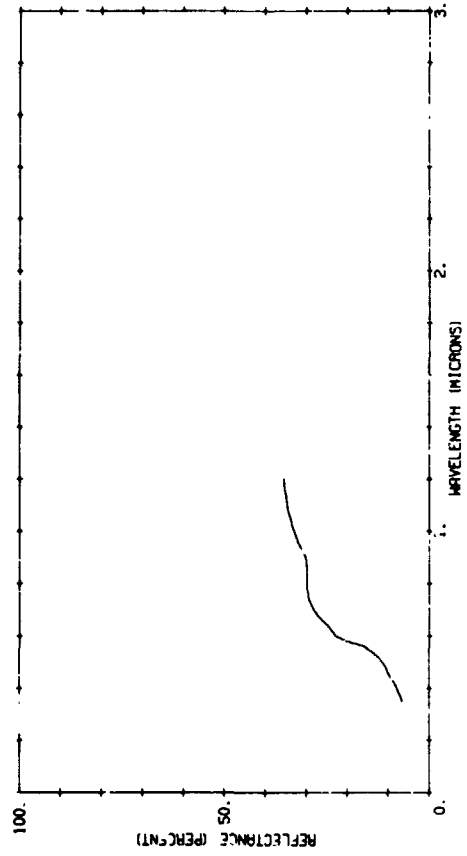
A09038 101

RHYOLITE BRECCIA (2B6) PISGAH CRATER FRESH.



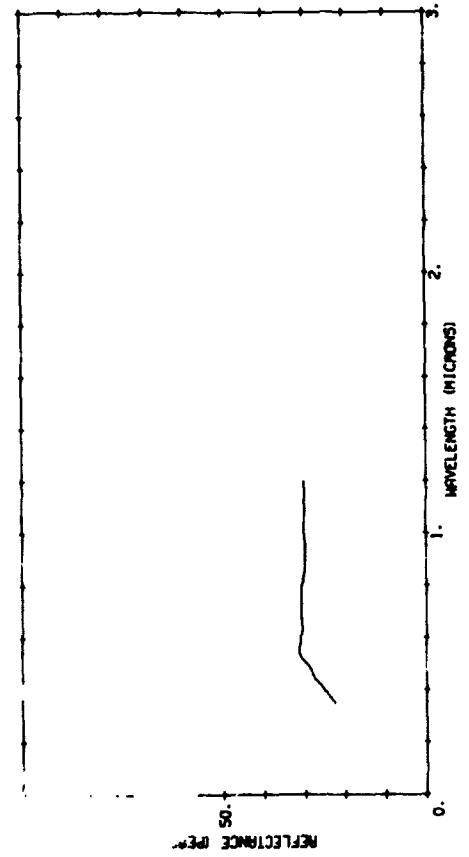
A09038 201

RHYOLITE BRECCIA (2B6) PISGAH CRATER WEATHERED.



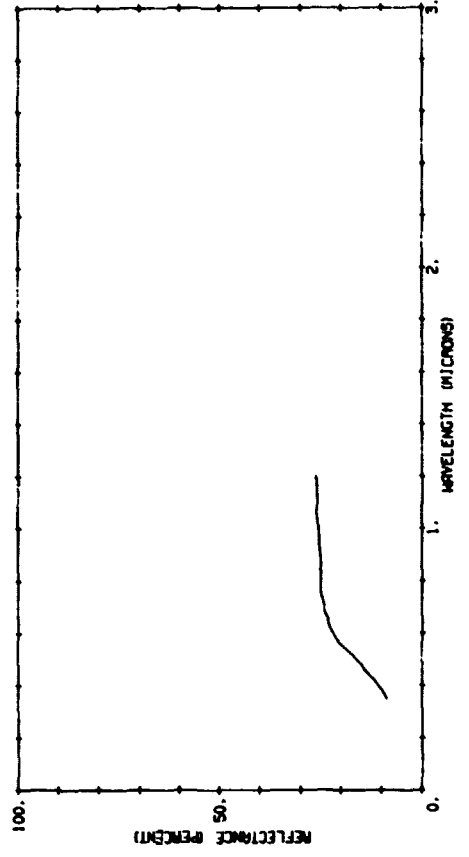
R09037 101

MONZONITE (L) PISGAH CRATER FRESH SURFACE



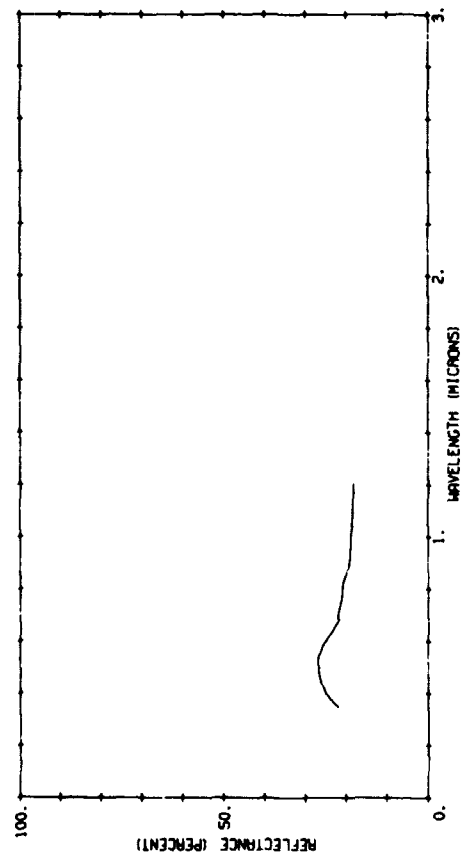
R09037 201

MONZONITE (BS) PISGAH CRATER WEATHERED SURFACE



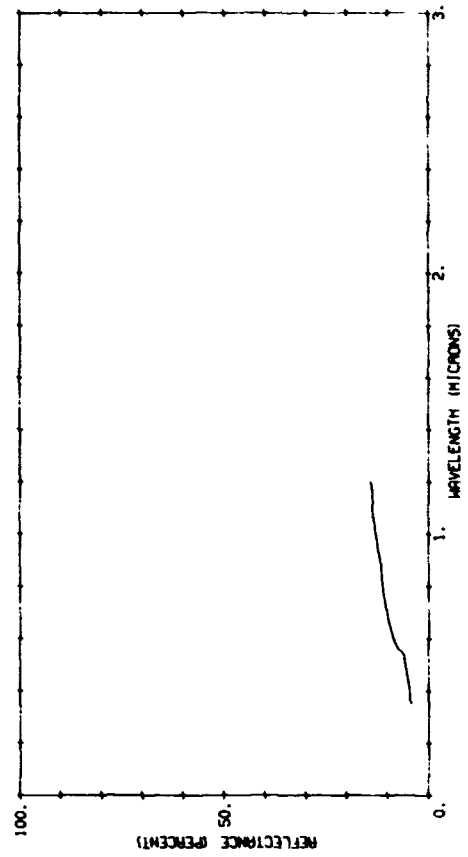
R09030 101

MONZONITE PORPHYRY (2A7) PISGAH SAMPLE FRESH



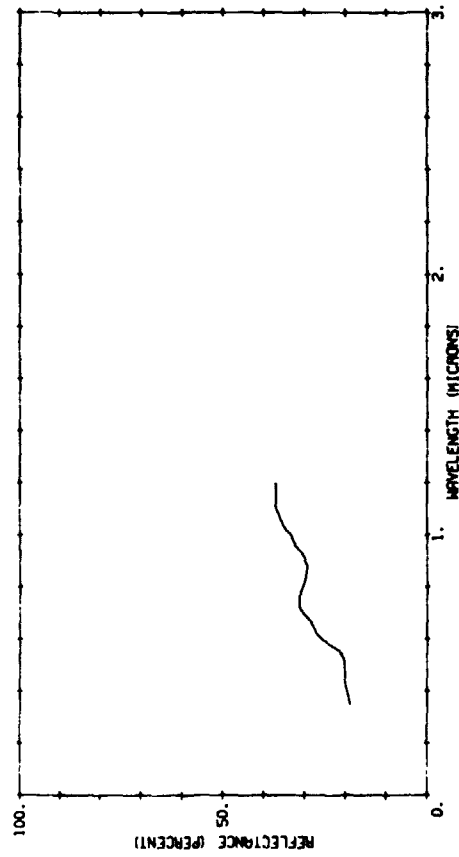
R09030 201

MONZONITE PORPHYRY (2A7) PISGAH SAMPLE WEATHERED.



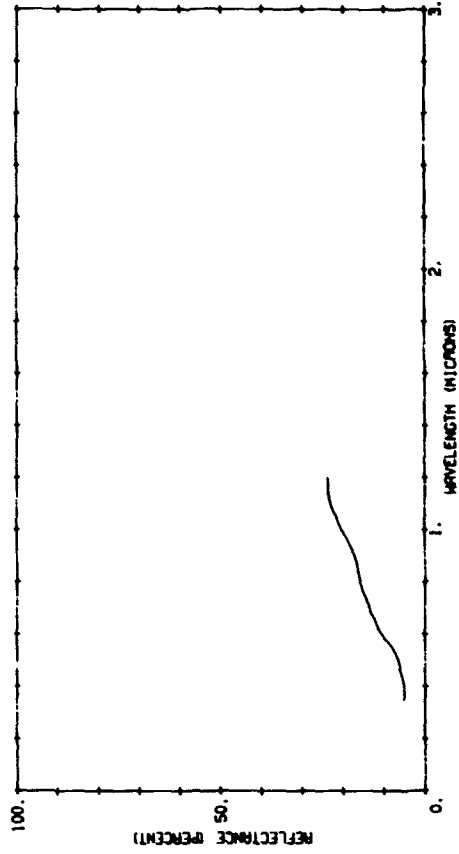
A09032 101

VESICULAR RHYODACITE (2A9) PISGAH SAMPLE FRESH



A09032 201

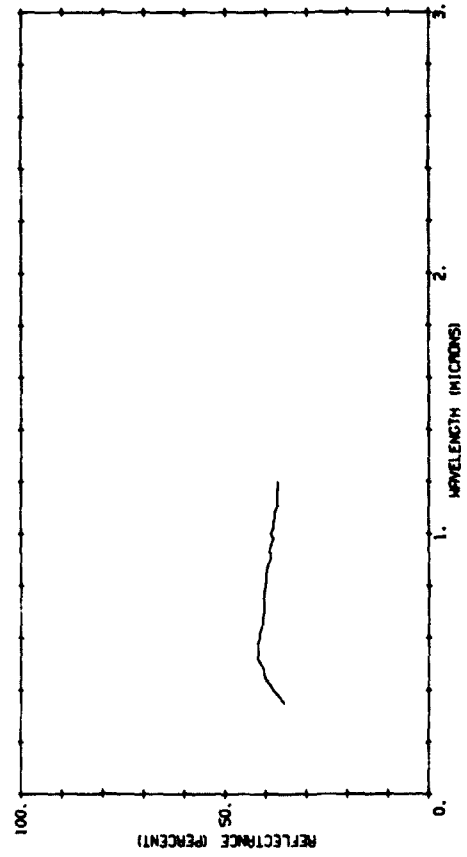
VESICULAR RHYODACITE (2A9) PISGAH SAMPLE WEATHERED



14 - 5

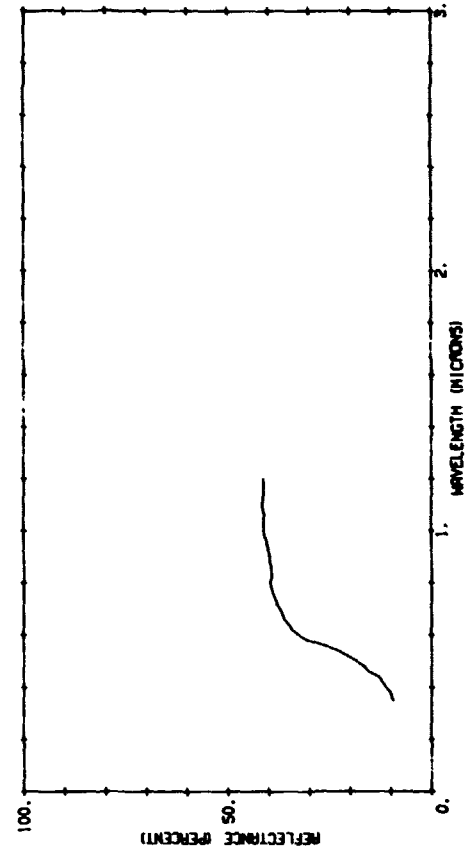
A09024 101

QUARTZ MONZONITE (2A2) PISGAH SAMPLE FRESH



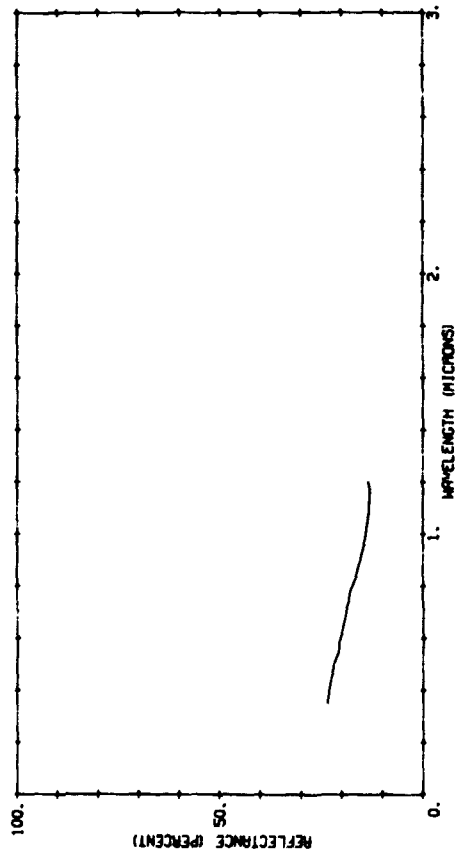
A09024 201

QUARTZ MONZONITE (2A2) PISGAH SAMPLE WEATHERED



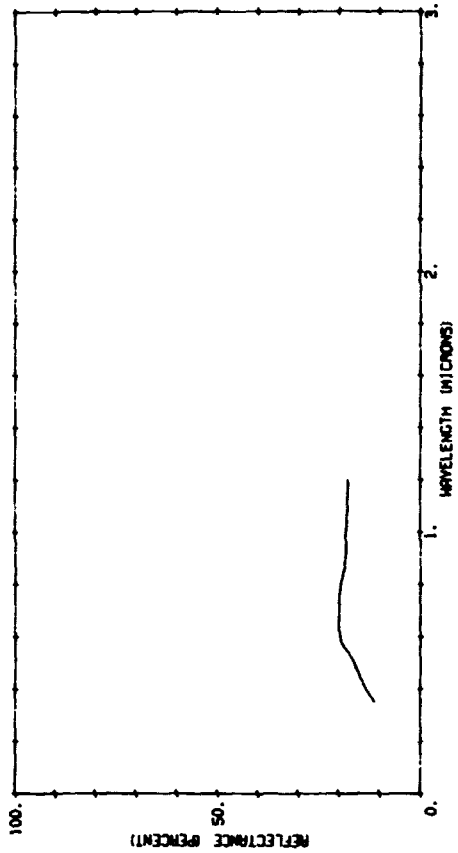
A09033 101

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



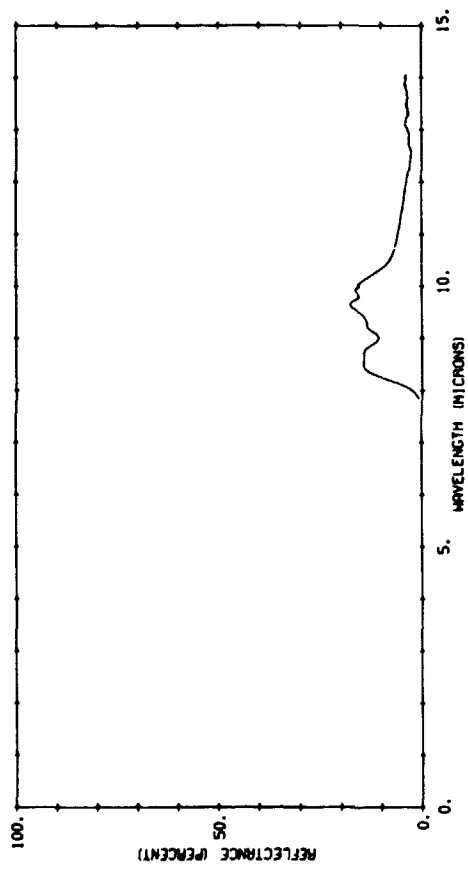
A09033 201

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



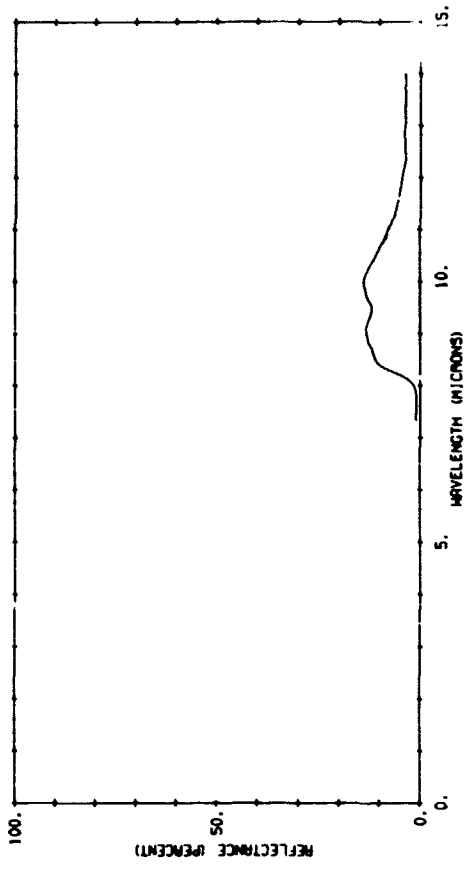
B09019 1

GRANITE (A19)



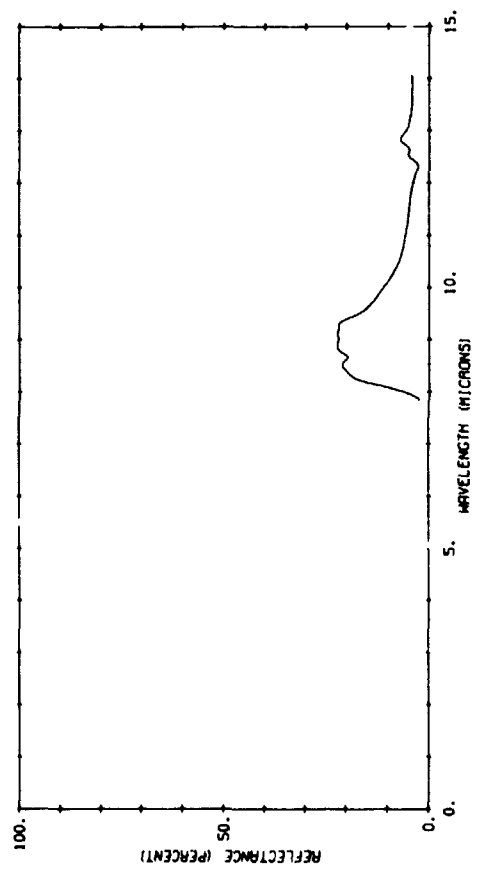
B09019 2

GRANITE (A119)



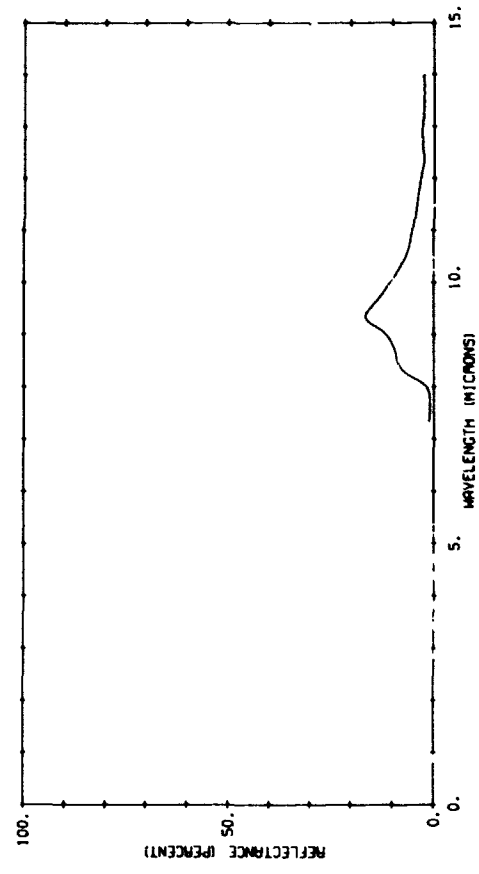
B09019 4

RHYOLITE (SA-49)



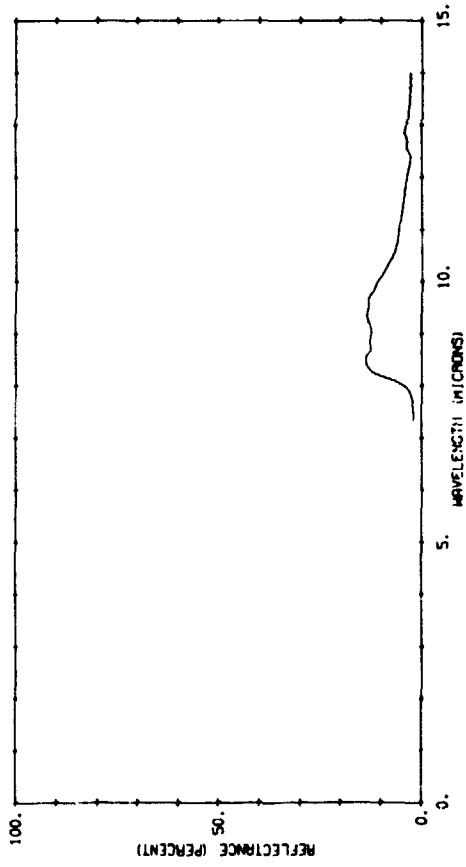
B09019 5

RHYOLITE (WELDED TUFF)



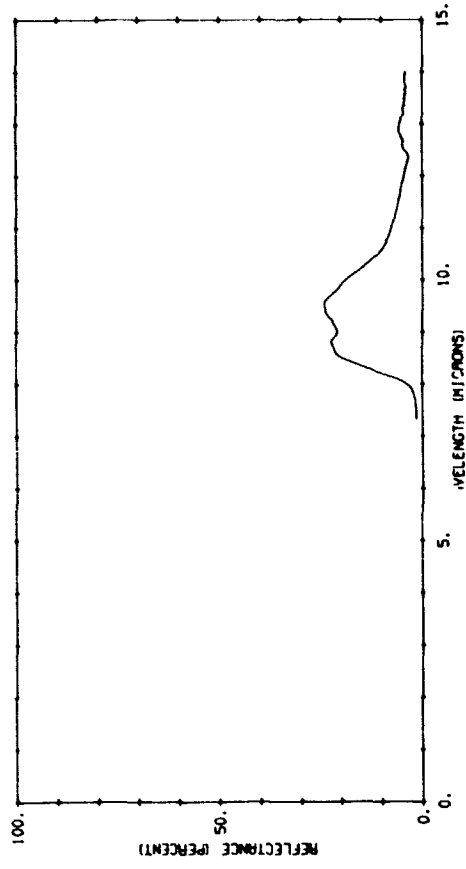
809019 11

DACITE (E12A)



809019 17

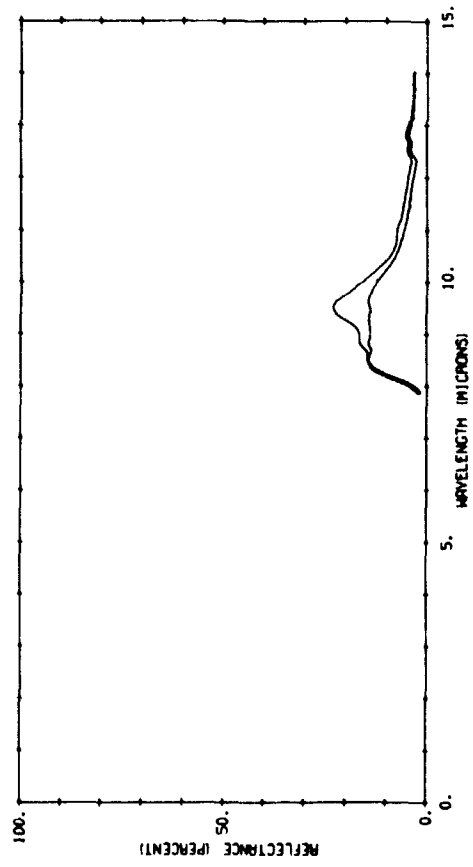
RHYODACITE (2A3)



10 - 8

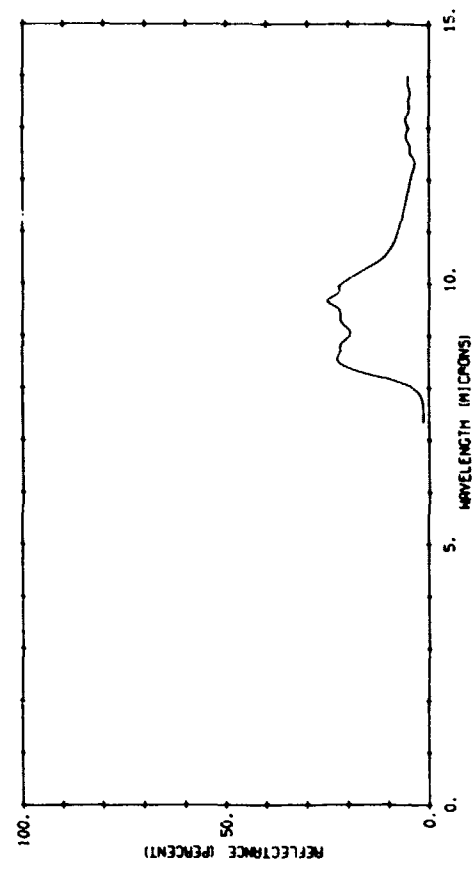
809019 013

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



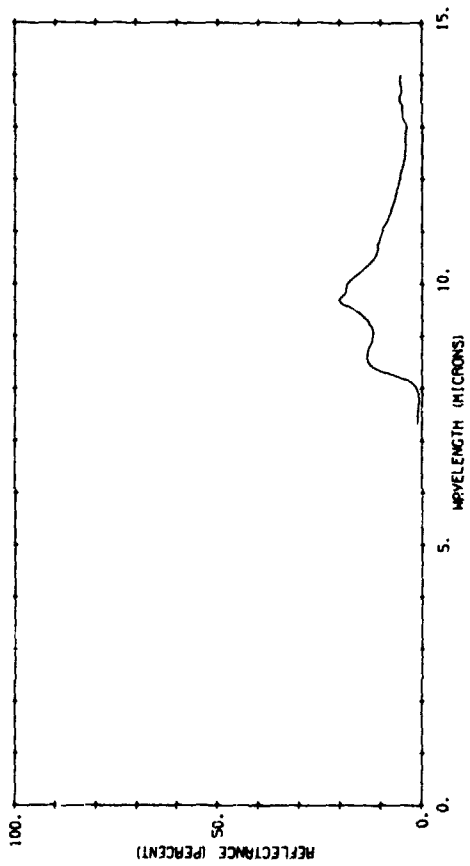
809019 7

TRACHYTE



B09019 3

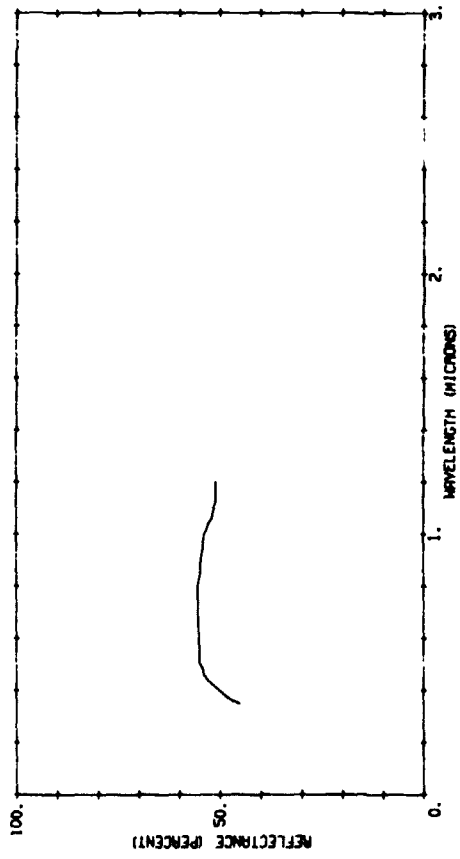
GRANITE (A122)



102
INTERMEDIATE SILICATE ROCKS
(Generally 53% to 65% SiO_2)

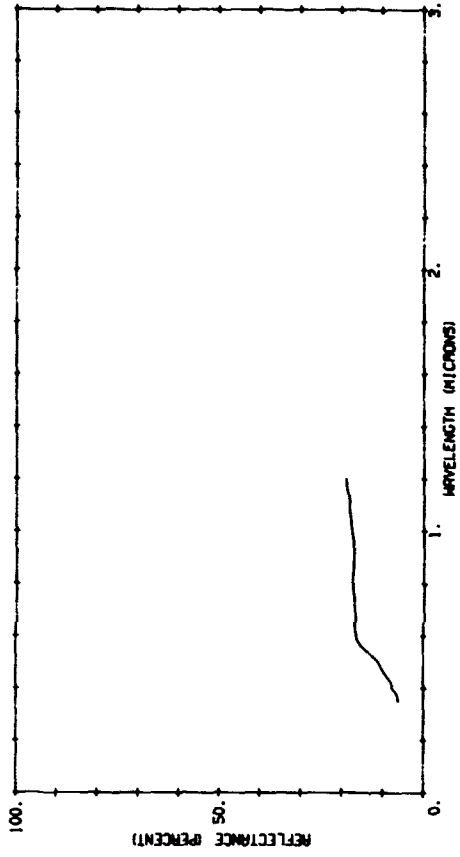
R09029 101

SYENITE TO SYENOCRANITE (2A6) PISGAH SAMPLE FRESH



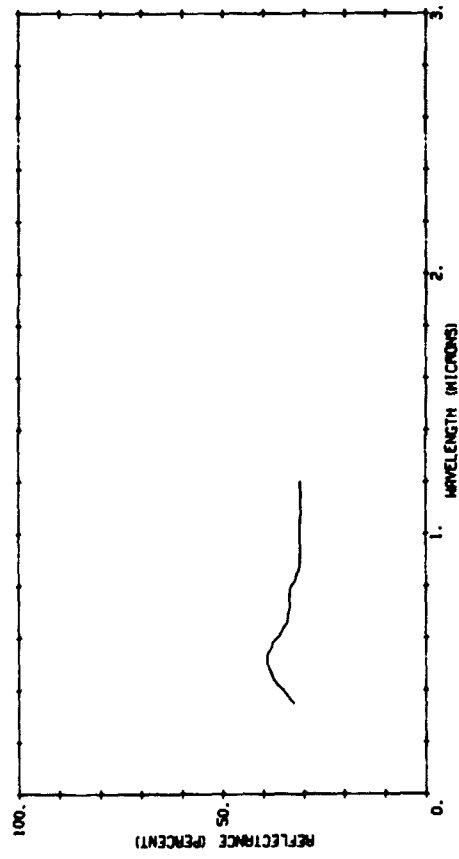
R09029 201

SYENITE TO SYENOCRANITE (2A6) PISGAH SAMPLE WEATHERED



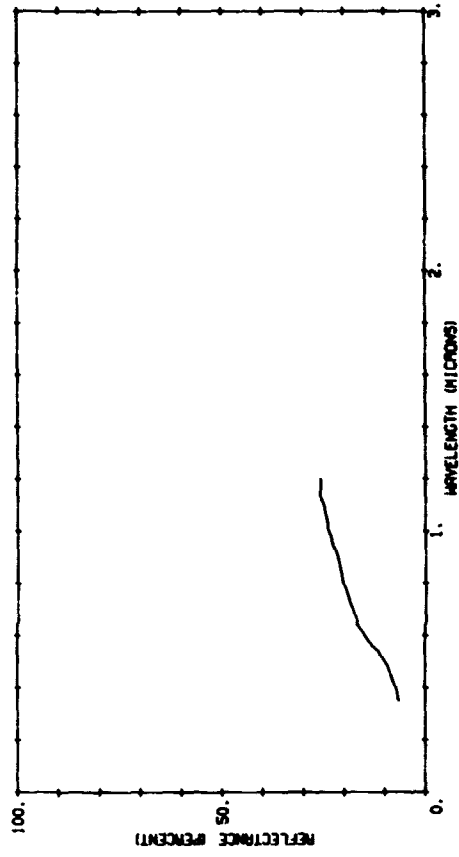
R09023 101

MONZODIORITE PORPHYRY (2A1) PISGAH SAMPLE FRESH



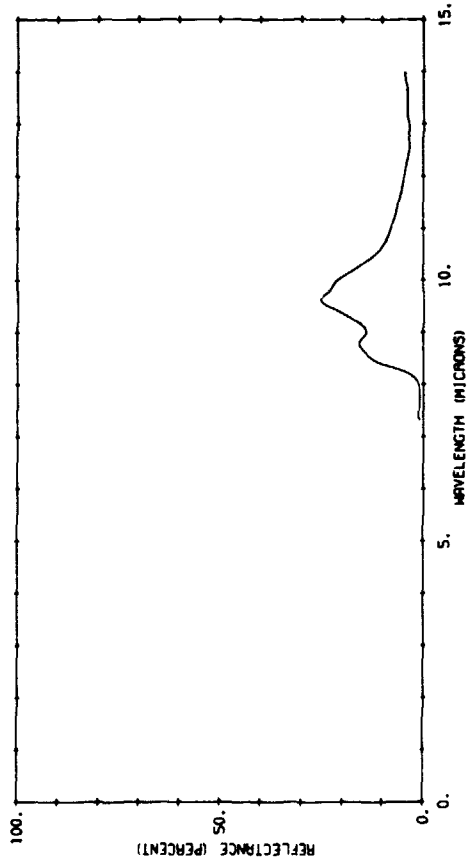
R09023 201

MONZODIORITE PORPHYRY (2A1) PISGAH SAMPLE WEATHERED



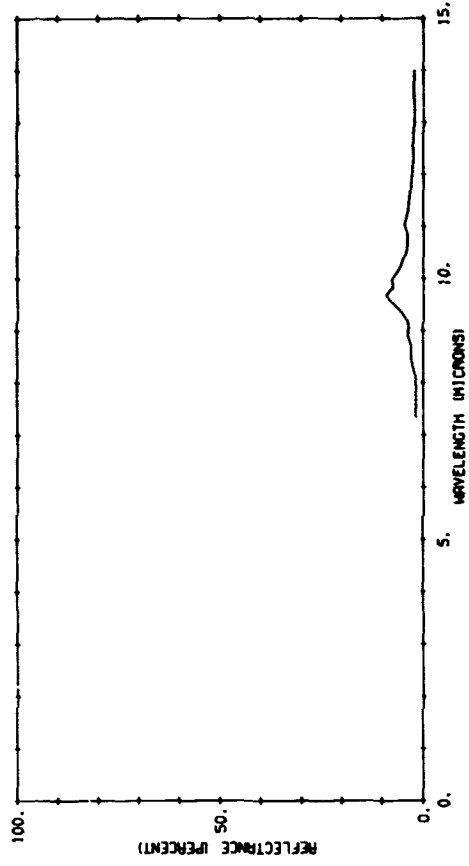
B09019 6

SYENITE (893A)



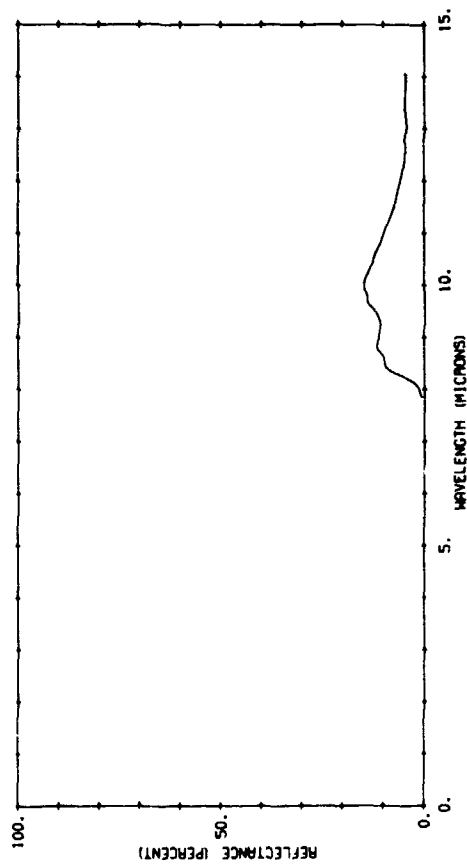
B09019 8

NEPHELINE SYENITE



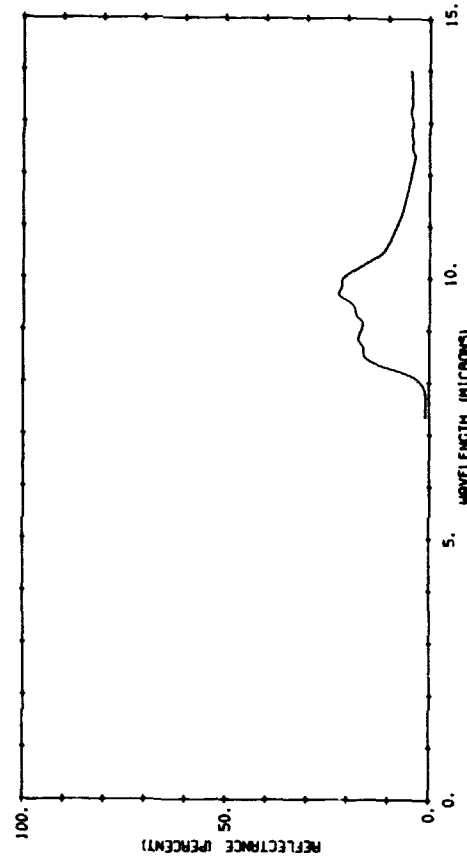
B09019 9

GRANODIORITE (A117)



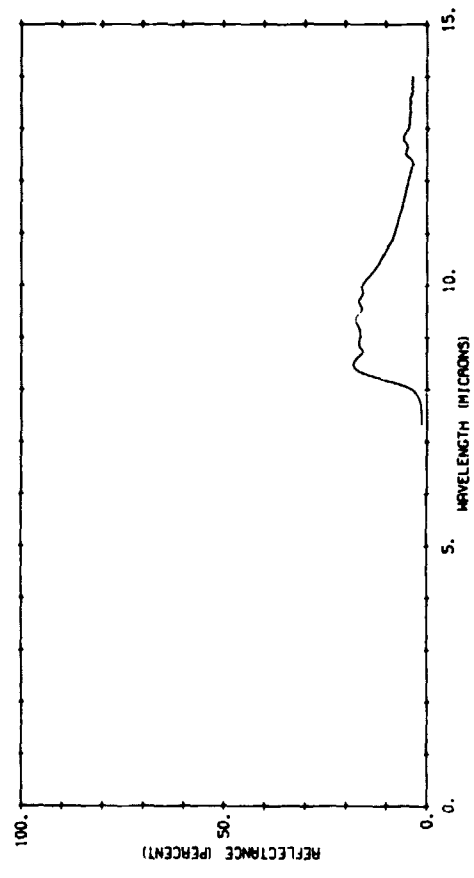
B09019 10

GRANODIORITE (A127)



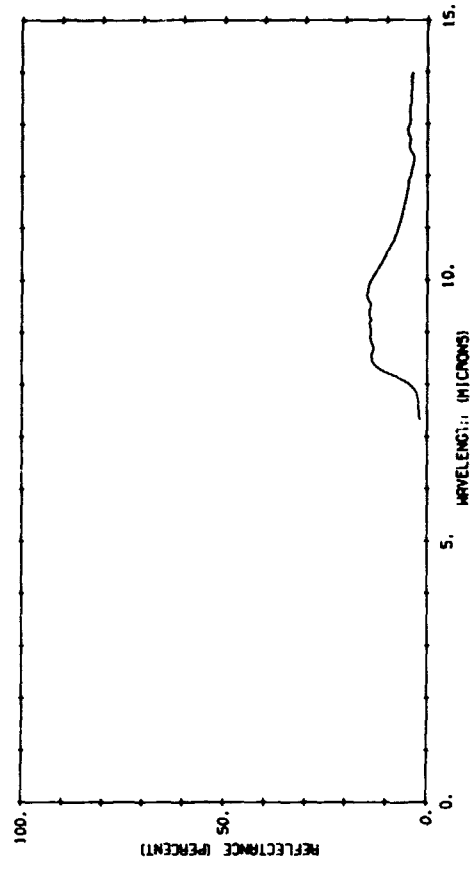
B09019 14

DIORITE (A129)



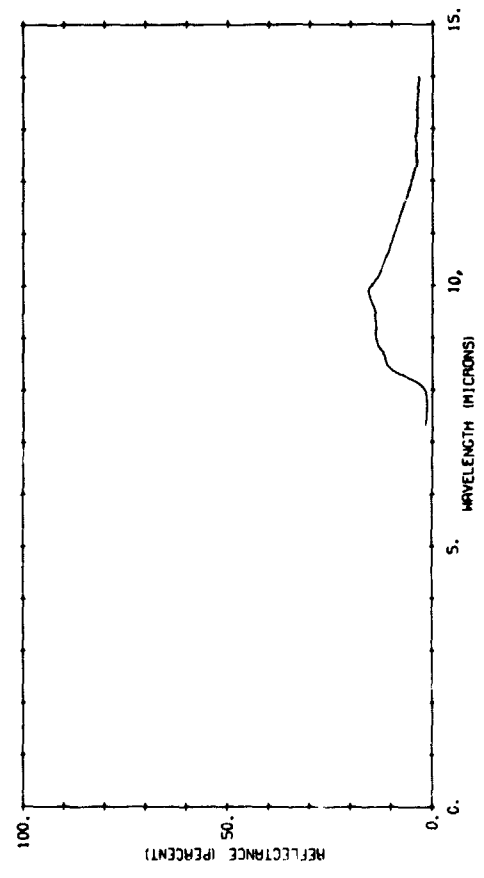
B09019 15

DIORITE (E47C)



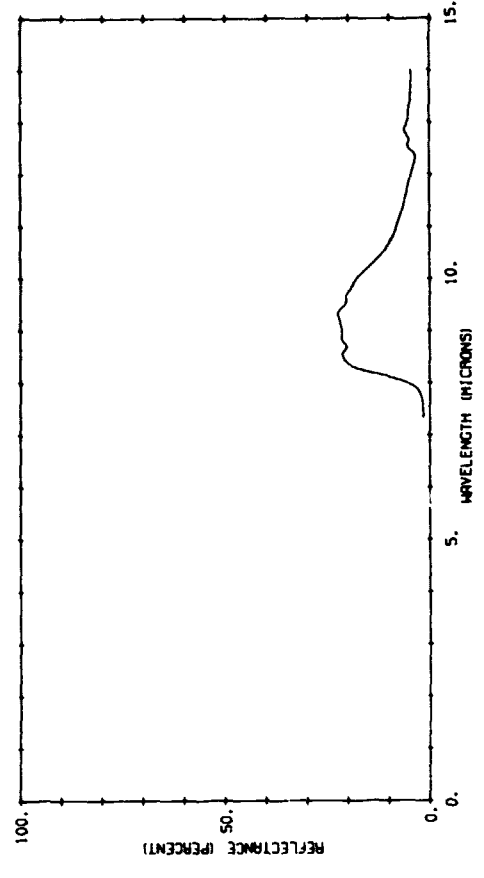
B09019 16

ANDESITE (E55A)



B09019 12

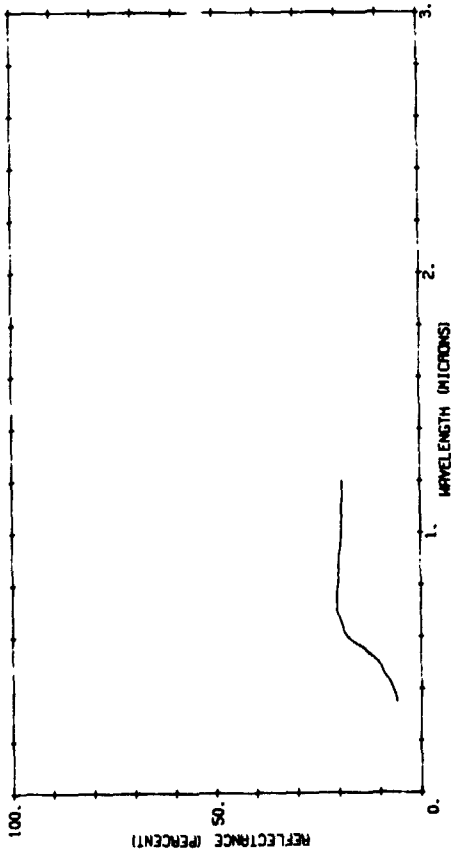
MONZODIORITE PORPHYRY (Z41)



BASIC AND ULTRABASIC SILICATE ROCKS
(Generally less than 53% SiO_2)

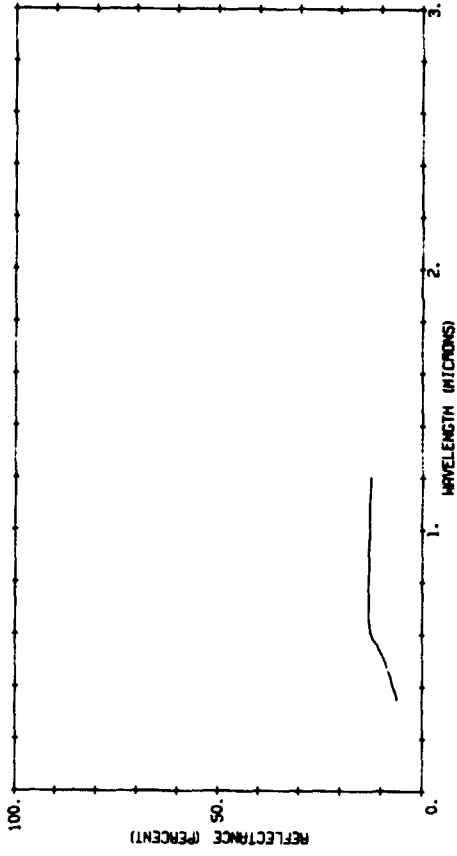
R09001 101

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



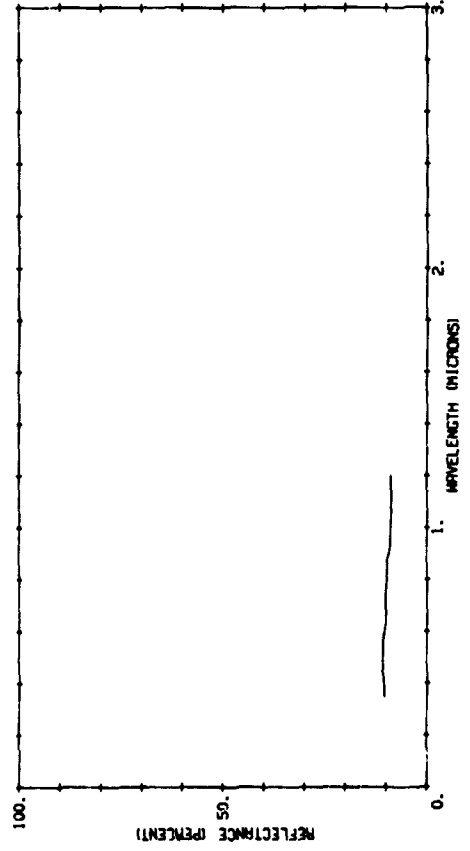
R09001 201

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



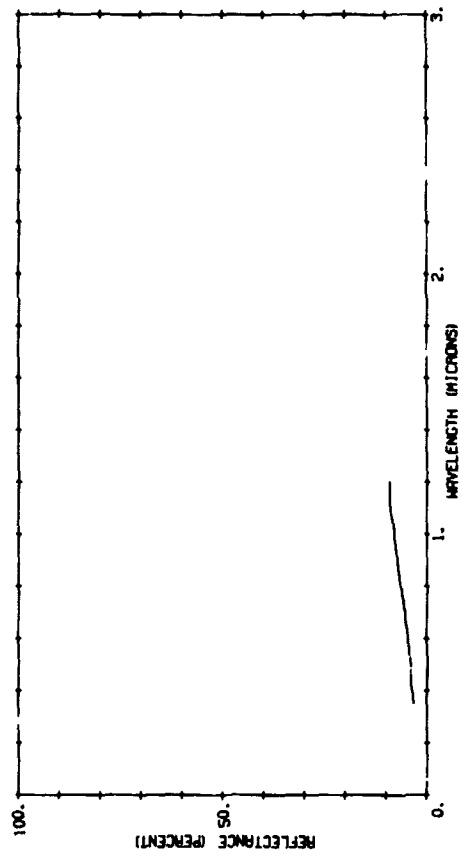
R09002 101

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



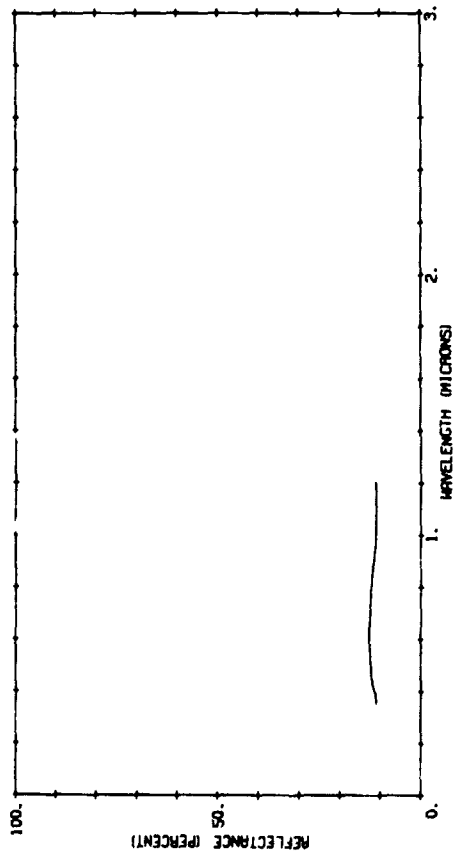
R09002 201

BASALT PHASE 2 PISGAH (1A2) BOTTOM SURFACE.



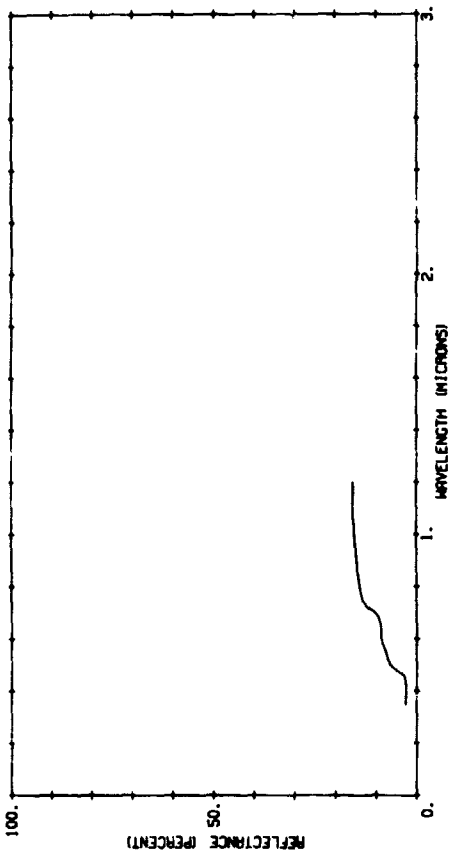
R09003 101

BASALT PHASE 2 PISGAH (1A2) BOTTOM SURFACE.



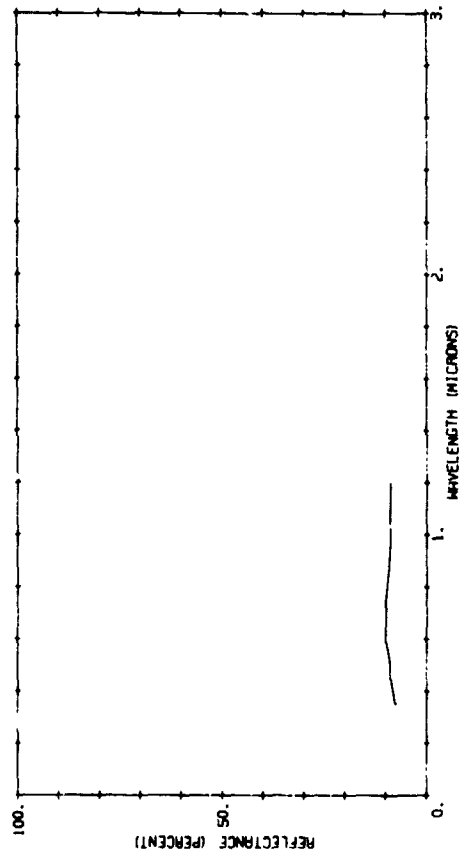
R09003 201

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



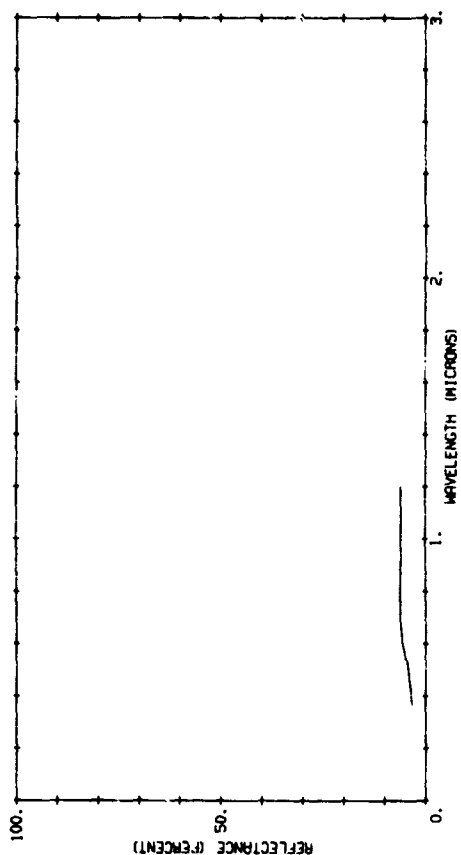
R09004 101

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



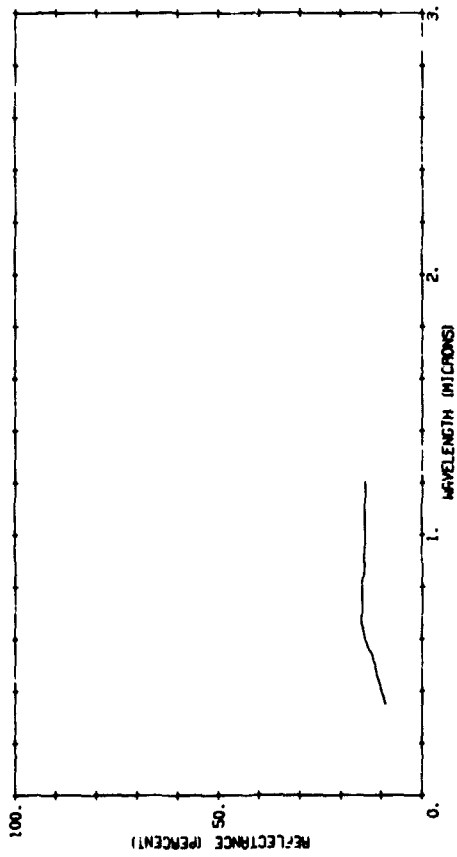
R09004 201

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



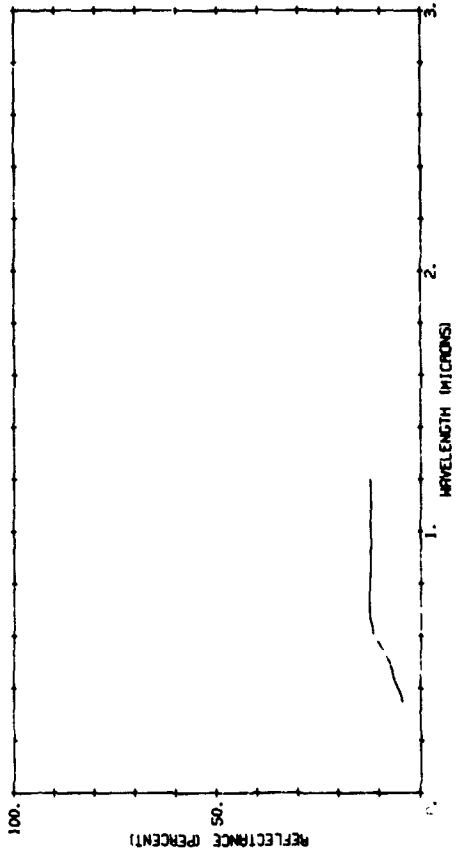
A09005 101

BASALT (PARC:HOE) ON ALLUVIUM (1A4) BOTTOM SURFACE



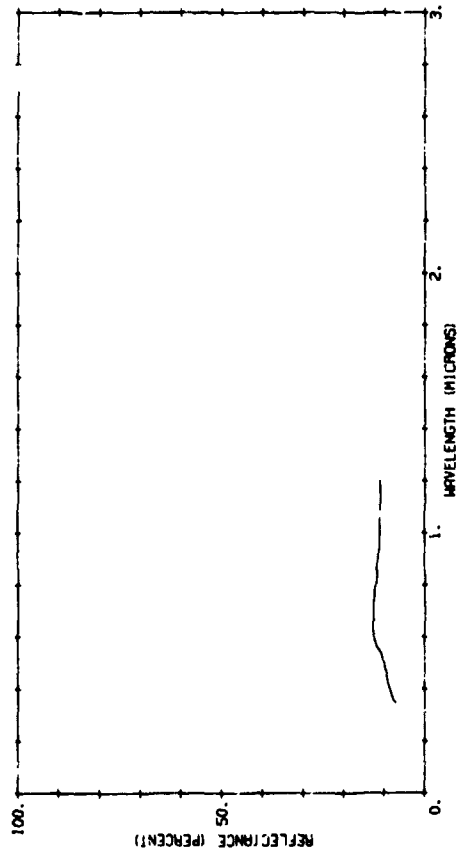
A09005 201

BASALT (PARC:HOE) ON ALLUVIUM (1A4) TOP SURFACE



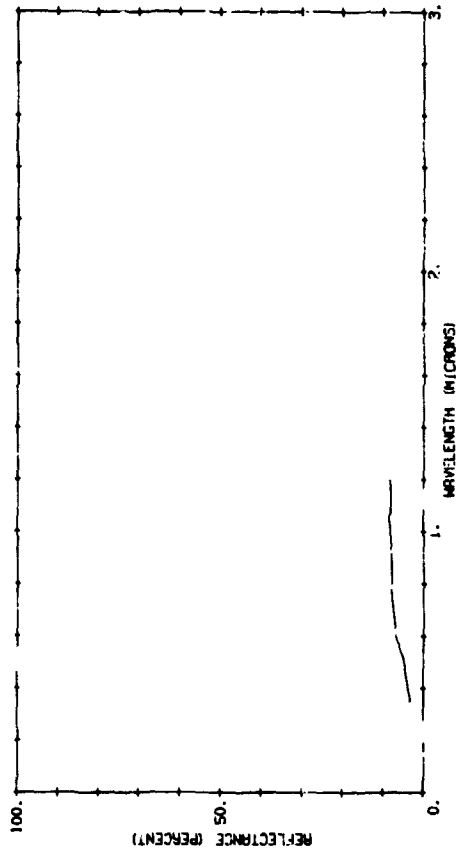
A09007 101

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



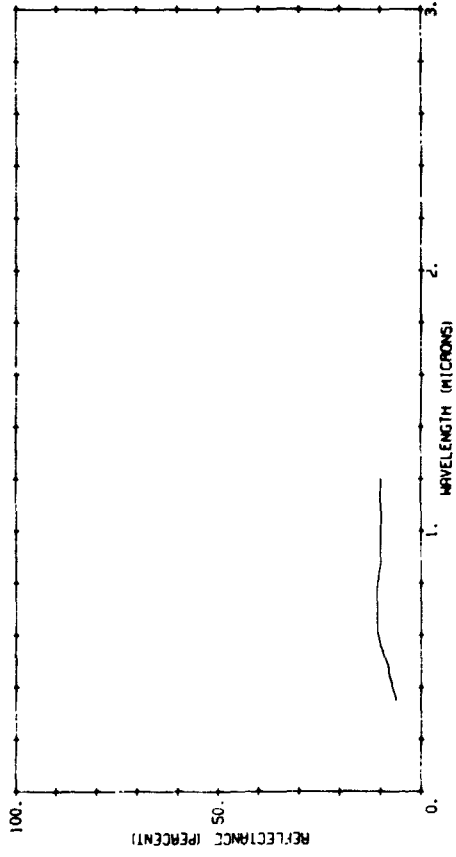
A09007 201

BASALT (AA) TOP OF PENINSULA (1A6S) W/ FATTY J



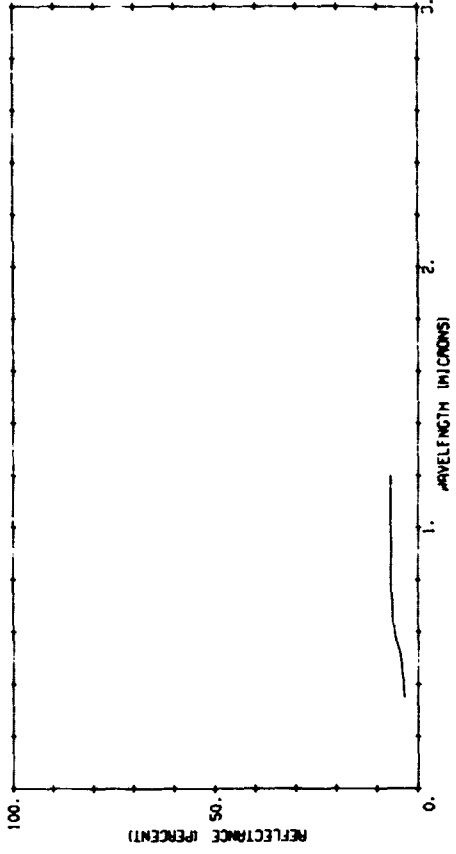
R09008 101

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



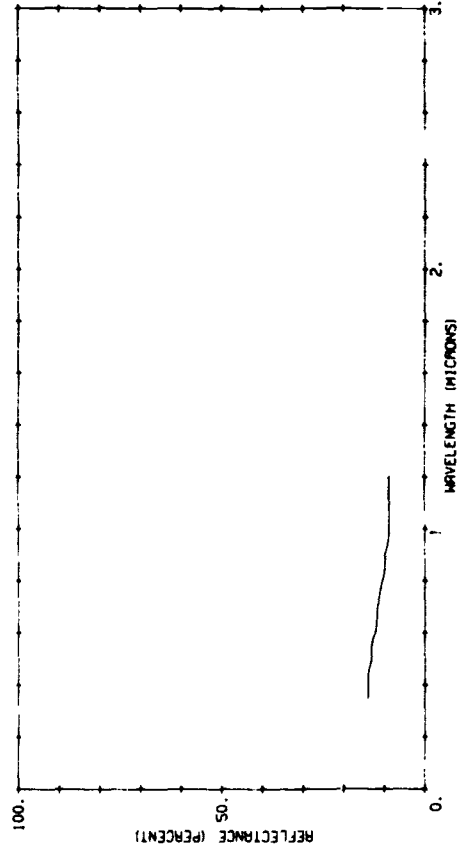
R09008 201

BASALT PHASE 1 PISGAH LAVA (AA) TOP SURFACE (LAC)



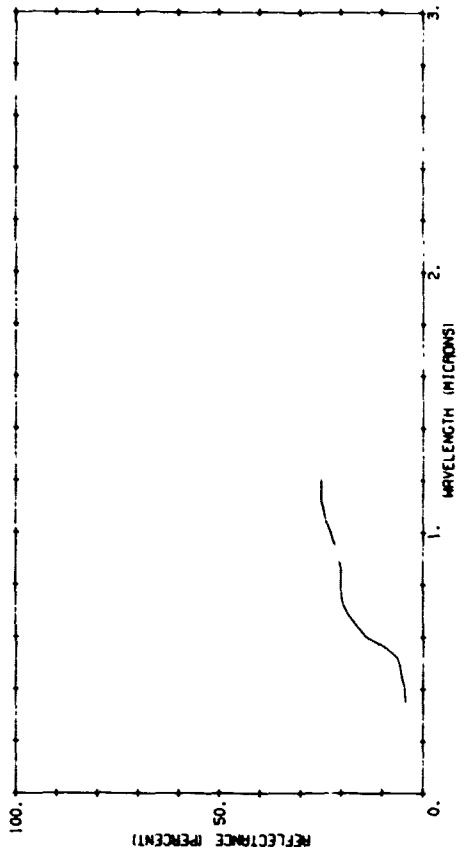
R09009 101

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



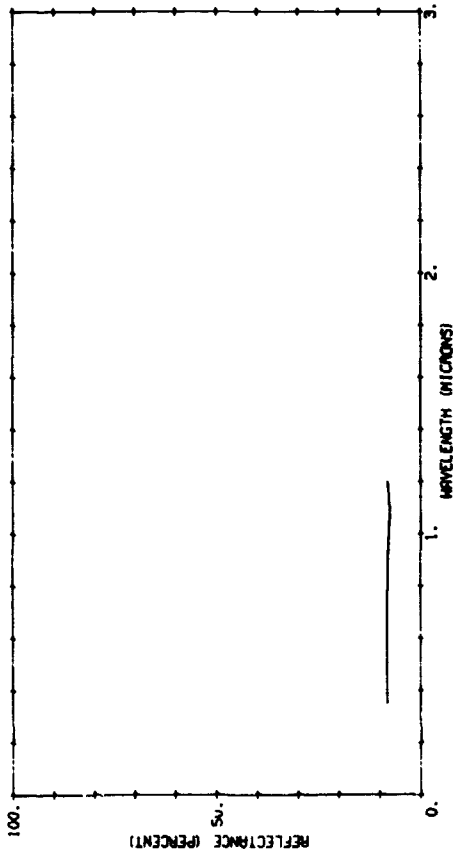
R09009 201

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



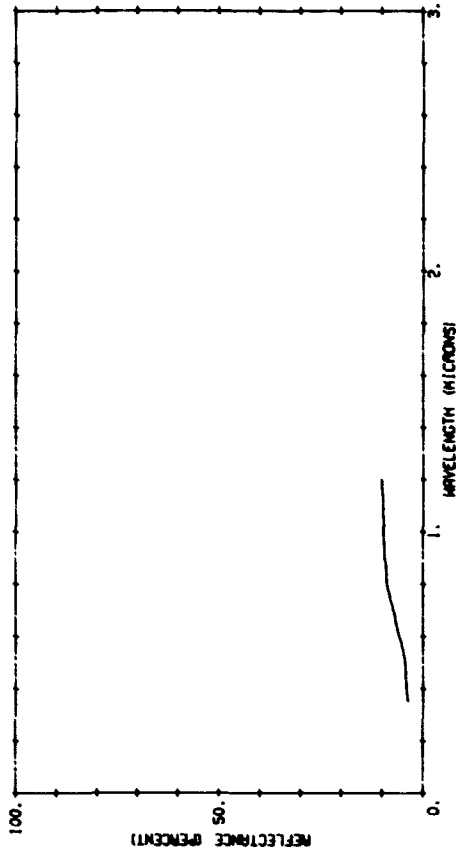
R09010 101

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



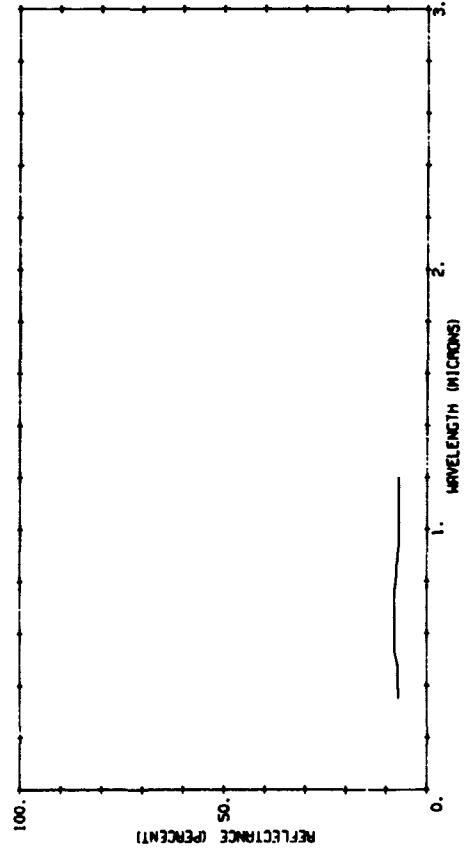
R09010 201

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



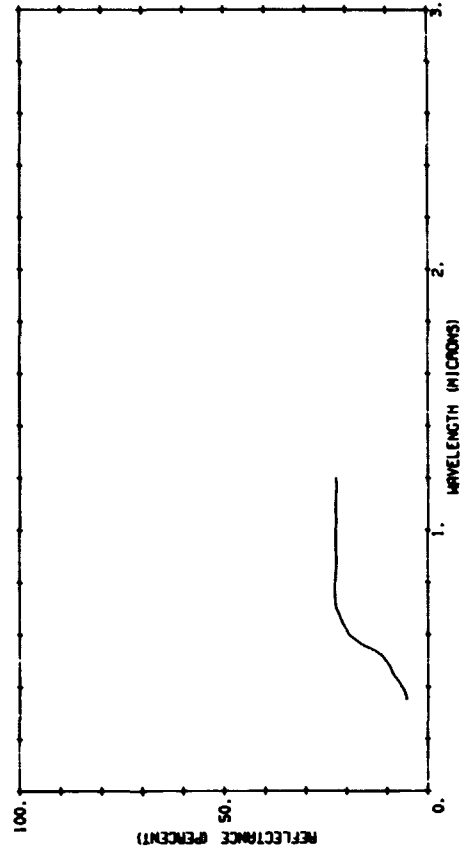
R09011 201

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



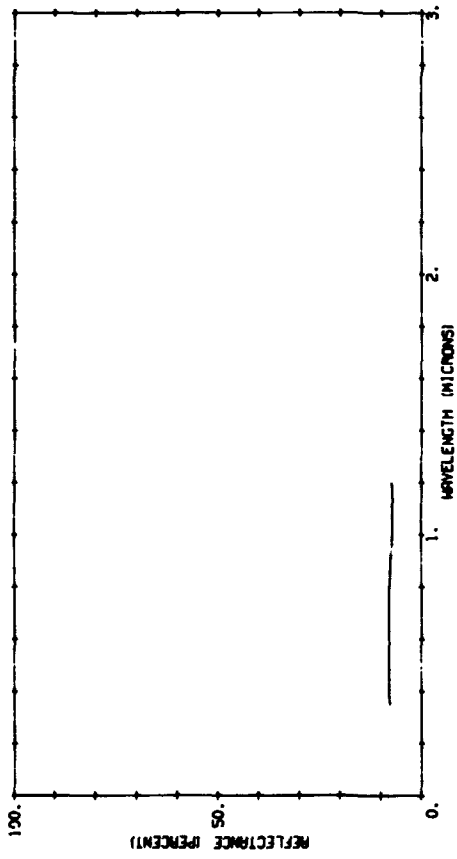
R09011 101

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



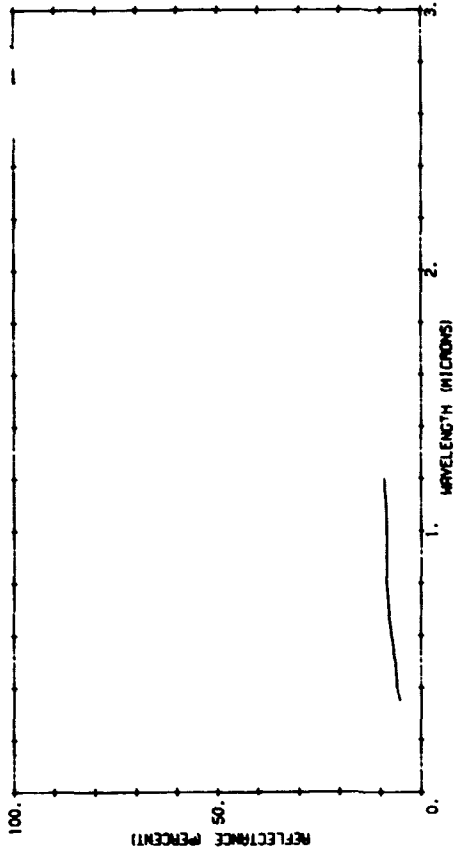
R09012 201

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



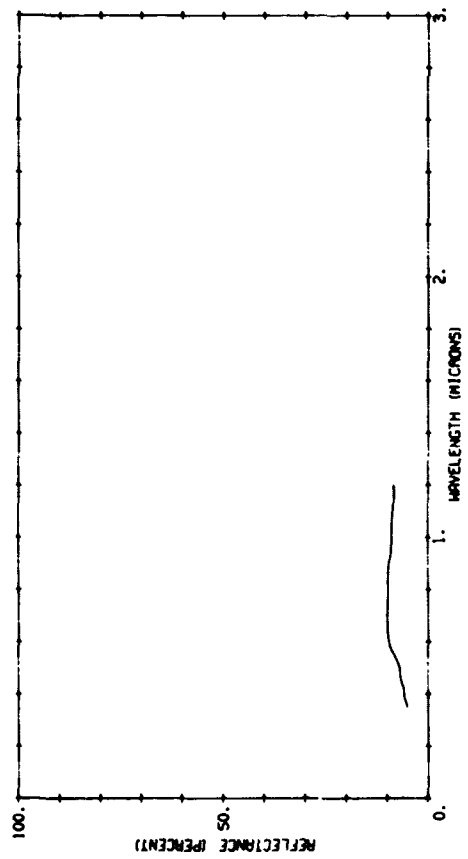
R09012 101

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



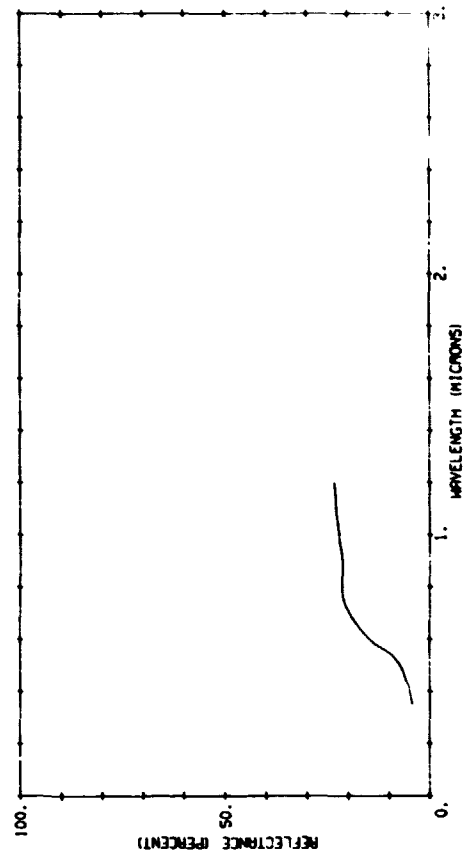
R09020 101

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



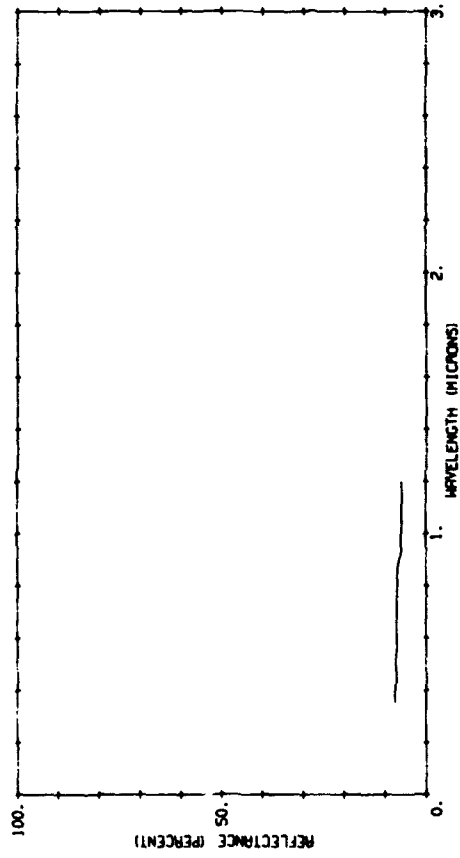
R09020 201

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



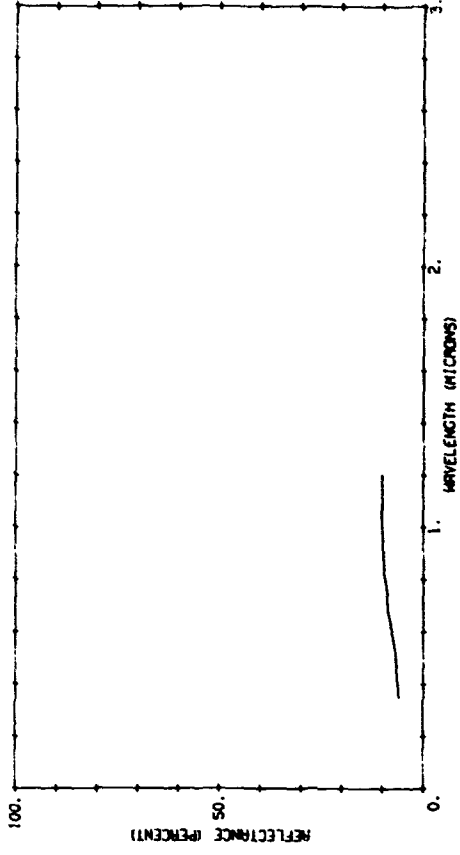
R09034 101

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



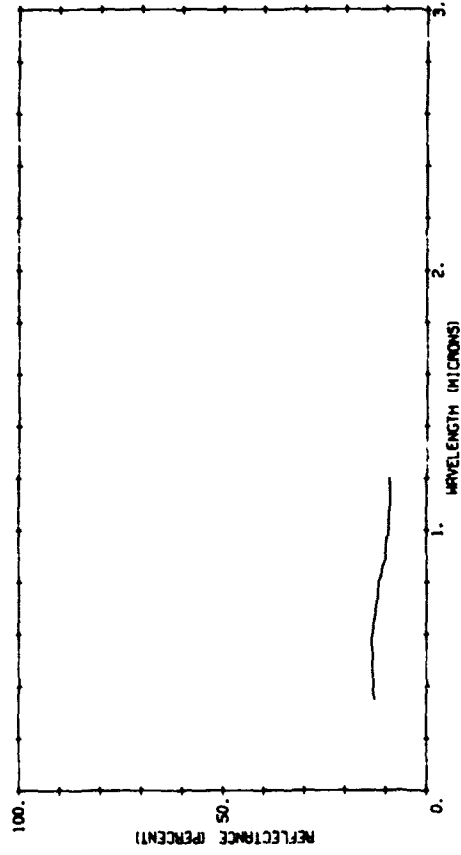
R09034 201

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



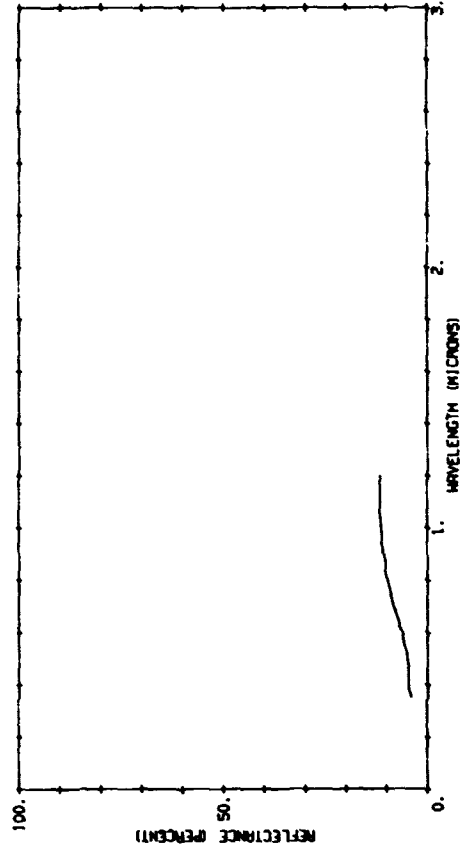
R09035 101

BASALT (2B3) FRESH SURFACE



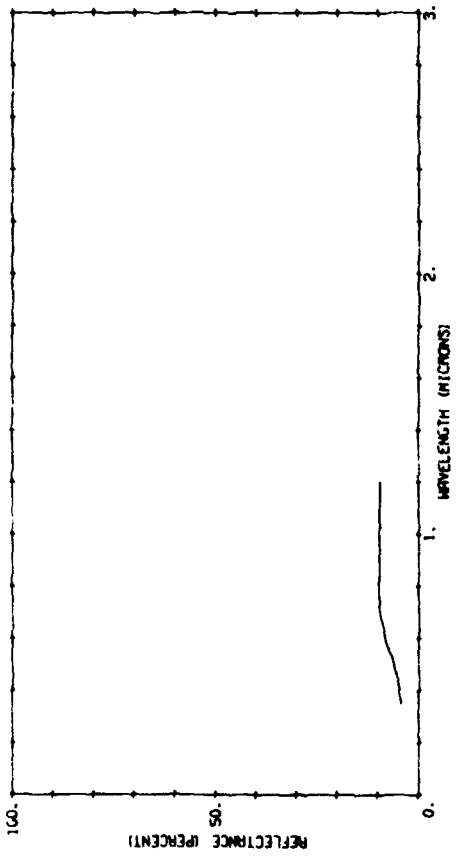
R09035 201

BASALT (2B3) WEATHERED SURFACE



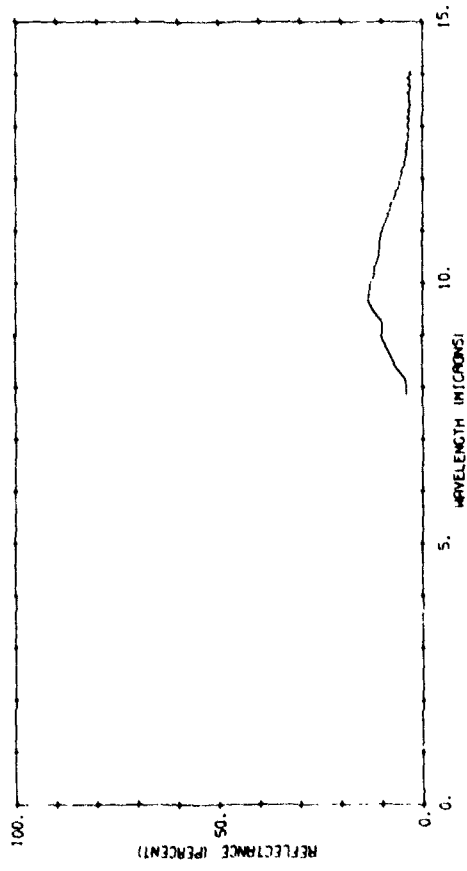
R09006 101

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



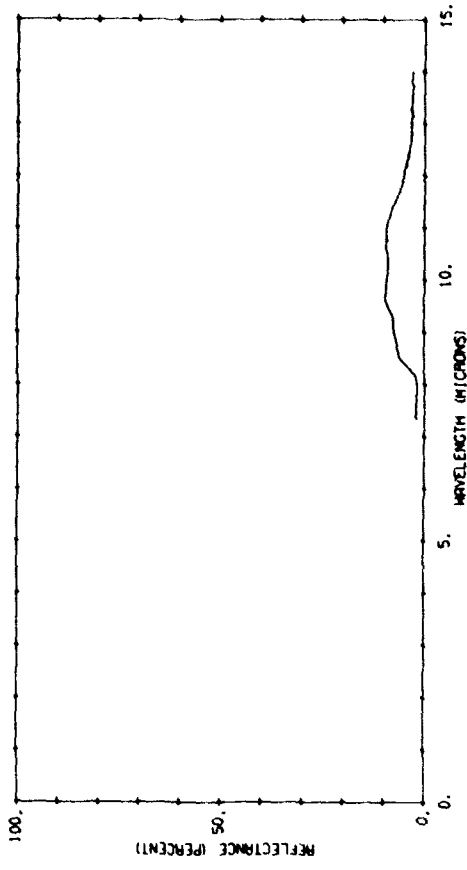
809019 19

BASALT (1A8)



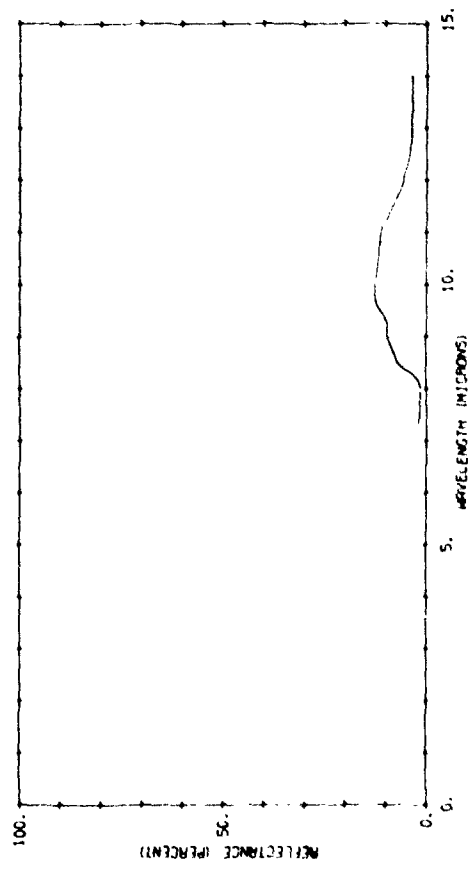
809019 20

BASALT (W1-1-108)



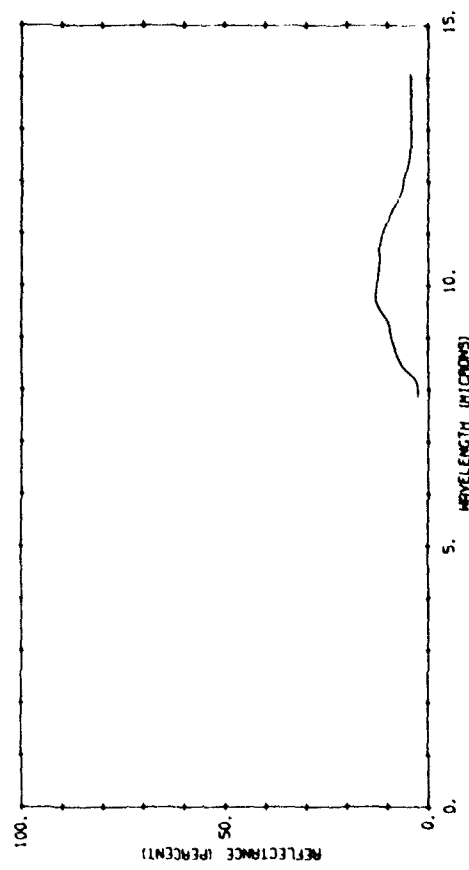
809019 21

BASALT (595)



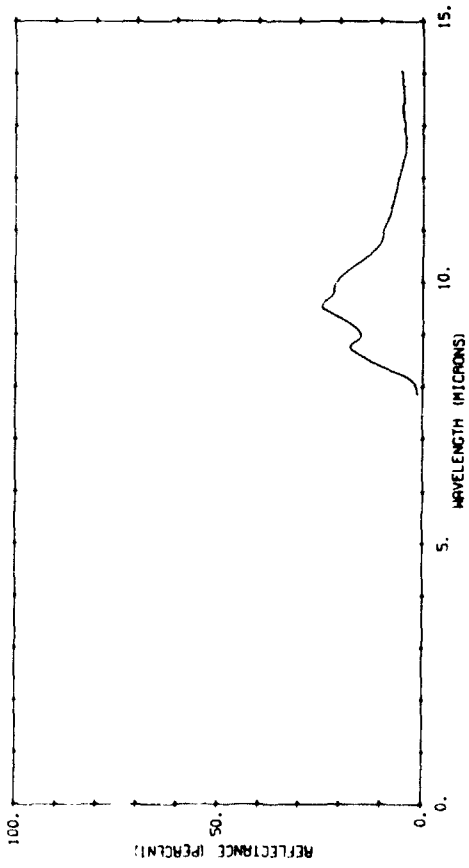
809019 22

BASALT (584)



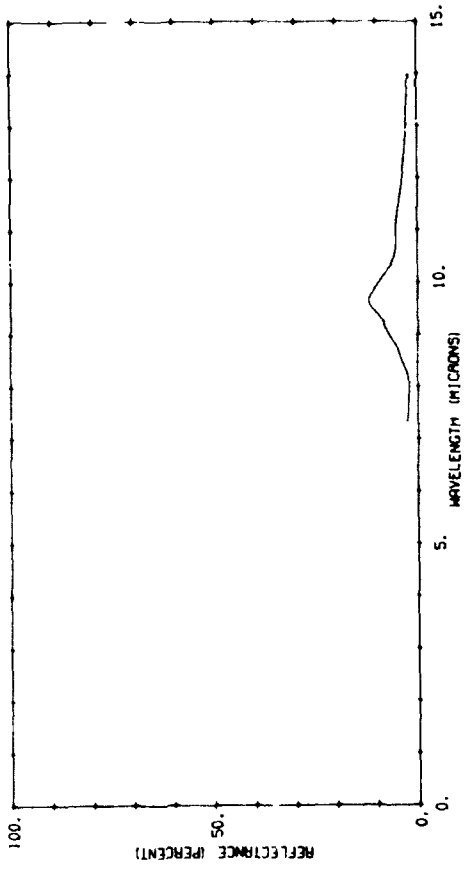
809019 18

GABBRO (E80A)



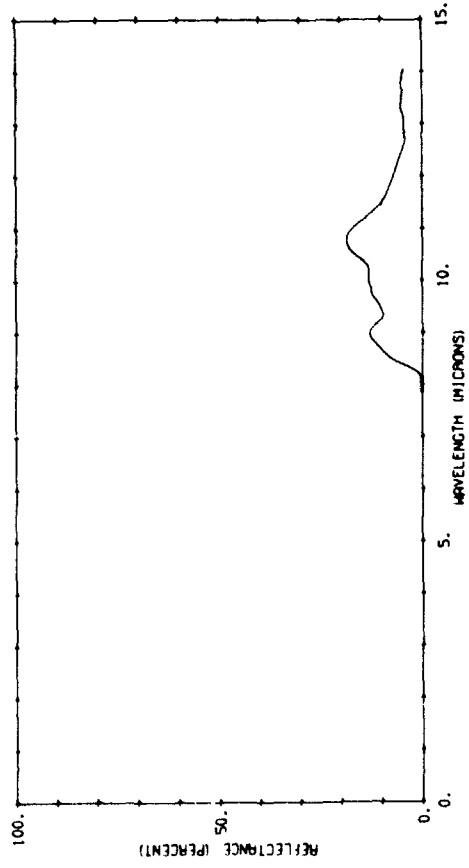
809019 23

BASALT (1A3)



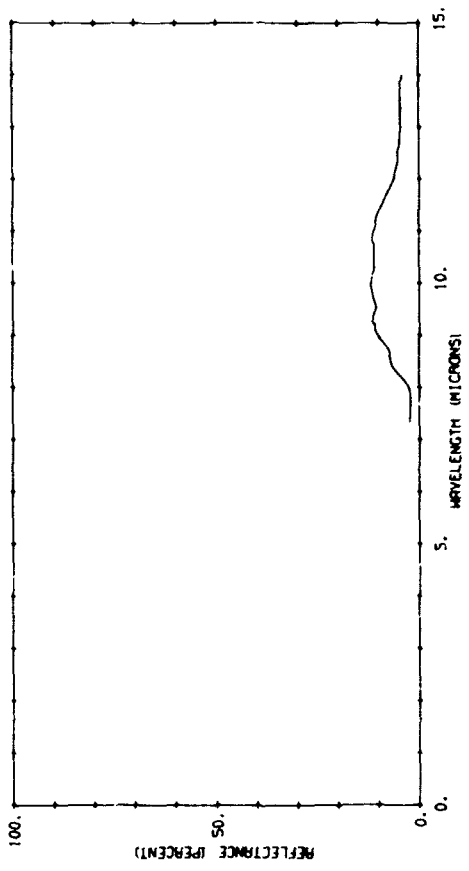
809019 24

ANORTHOITE



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 H02:0041 (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 x 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 MULTI-SPECTRAL 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.