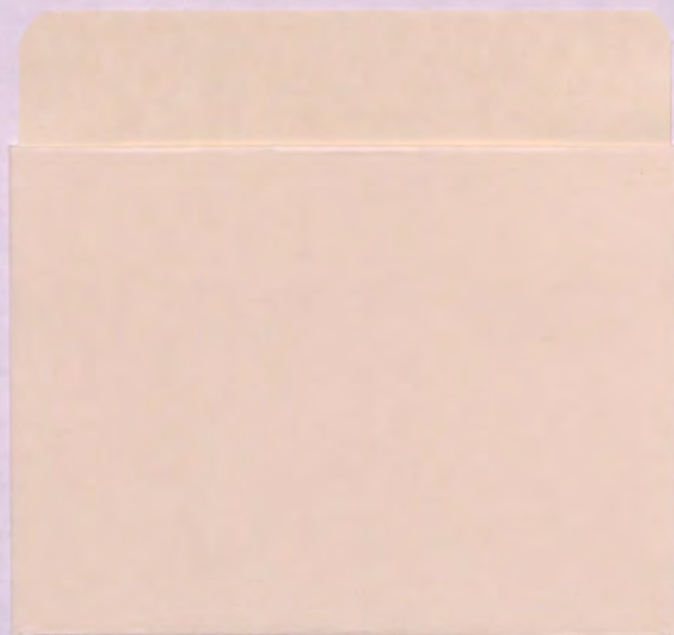




(200)
R290
no. 78-448



U. S. (Department of the Interior)

Geological Survey, [Reports - Open file series]

Spectral Reflectance Measurements of Plants in the
East Tintic Mountains, Utah

by

Nancy Milton
1978

TM

Em

Tworals

U. S. Geological Survey

Open-File Report 78-448

286833



Spectral Reflectance Measurements of Plants in the
East Tintic Mountains, Utah

Several workers have used spectral radiance differences recorded by the Landsat Multispectral Scanner (MSS) to distinguish among certain rock types in sparsely vegetated areas (Rowan and others, 1974, 1977; Blodgett, 1975; Offield, 1976; Vincent, 1977; Raines, in press). The most widely used method for displaying and analyzing these differences combines ratioing of the spectral bands for subduing brightness variations due to topographic slope and albedo and color-compositing for displaying the spectral radiance differences in color. This approach has proven to be especially effective for mapping limonitic rocks because of the distinctive spectral reflectance of limonite in the MSS response region (0.5-1.1 μm). A similar approach has been used for analyzing aircraft scanner data in the 0.4-2.5 μm region for making important rock type distinctions that cannot be reliably made using MSS data (Abrams and others, 1977; Ashley and Abrams, 1977).

The presence of even modest amounts of vegetation causes large changes in the spectral radiance measured by satellite and airborne scanners because of the large spectral contrast between most plants and rock types (Siegal and Goetz, 1976). Thus, variations in the areal density and type of vegetation is generally considered to be a limiting factor. In some cases, however, this type of information is beneficial, rather than detrimental, for mapping rock types (Raines and Canney, in press). Of particular interest in this study are areal density and species variations associated with hydrothermal alteration.

Vegetation changes related to alteration have been described for several areas (Billings, 1950; Canney and others, 1970; Salisbury, 1964; Howard and others, 1971; Lag and Bolviken, 1974; Lyon, 1975); however, development of methods for remote detection of these areas has been limited by a general lack of spectral reflectance information for plants growing in altered and surrounding unaltered areas. In most previous studies, the spectral reflectance has been measured for plant parts, usually individual leaves, cut in the field and removed to the laboratory (Gates and Tantraporn, 1952; Billings and Morris, 1951). Water content is an important factor in leaf reflectance, and dessicated leaves would be expected to reflect differently from leaves measured in situ. Although in situ measurements have been made in a few areas, the samples have been restricted with respect to either number of spectra or species (Pearson and others, 1976; Canney and others, 1970; Howard and others, 1971).

In the present study, the spectral reflectance of 17 desert trees, shrubs and grasses were measured in the field. The main purpose of this report is to make these in situ spectra available to other workers. No analysis is presented, but general descriptions of the study areas and sampling procedures are given. The study area is in the East Tintic Mountains, Utah near the eastern edge of the Great Basin (fig. 1). The area is classed as semi-arid desert, with about 12 in/yr (30.48 cm/yr) average precipitation, and average temperatures of 24⁰F (-4⁰C) in January and 70⁰F (21⁰C) in July. Topography in the range is moderately rugged with elevations up to 8306 ft (2500 m) but the measurements reported here were taken between 5500 ft (1700 m) and 6500 ft (1970 m) in August 1977.

The geologic setting is characterized by folded and faulted Paleozoic sedimentary rocks, which are partially covered by Tertiary volcanic rocks (Morris, 1957, 1964a and b, 1975; Morris and Lovering, 1961). Clastic rocks dominate the lower one-third of the Paleozoic section, whereas carbonate rocks with subordinate amounts of shale and clastic rocks predominate in the remainder. Emplacement of Tertiary monzonite porphyry bodies resulted in several types of altered rocks. Most widespread are argillized and silicified rocks, which are commonly bleached and limonitic (Lovering, 1949). Locally, the intrusive rocks are also altered. Hydrothermal dolomite is common in the northern part of the area, and in the East Tintic mining district, calcitic, chloritic, and weakly argillized volcanic rocks and pebble dikes are widespread. Volcanic rocks subjected to an early phase of "intravolcanic weathering" in this district are weakly altered but limonitic (Lovering, 1949).

The vegetation is part of the Upper Sonoran member of the Great Basin flora. *Artemisia tridentata* Nutt. is the dominant shrub, usually accompanied by *Chrysothamnus* spp., *Pursia tridentata* (Pursh) DC, and other shrubs. *Juniperus osteosperma* (Torr.) Little and *Pinus monophylla* Torr. and Frem. occur singly among the sages or in stands with or without sage.

Measurements were taken with the Portable Field Reflectance Spectrometer (PFRS) developed at the Jet Propulsion Laboratory of the California Institute of Technology, Pasadena, California (Goetz and others, 1975, Appendix E). Spectra were taken from 50-100 cm above the plant, and were calibrated using a Fiberfrax standard; absolute reflectance was obtained by correcting for the 0.4-2.5 μm response of Fiberfrax. The field of view of the PFRS is 200 cm^2 at approximately 130 cm above the plant. The broad field of view provides a combined measurement of varying proportions of leaves, twigs, background debris, and rocks and soil. The spectral range of the PFRS is 0.4-2.5 μm . Measurements were made vertically unless otherwise noted. Photographs of each major species are shown in figure 102.

Major species in each area were chosen on the basis of easy accessibility and a subjective determination of healthy condition, except as otherwise noted in figures 3-101. In addition, several minor species were measured. No attempt was made to choose randomly, and the data should not be considered a statistical sampling. Several plants were measured with and without a background of black plastic (figs. 5-13, 43-44, 55-56, 83-86). The spectrum of the black plastic alone is shown in figure 101. A *Cowania mexicana* D. Don spectrum was measured from a vertical position and from two oblique positions, one 45° from vertical, the other 60° from vertical (figs 76-78).

Several papers have discussed absorption and reflectance of water, plant pigments, and vegetation (Curcio and Petty, 1951; Gates, 1962; Knipling, 1970; Moss and Loomis, 1952; Shull, 1929; Stair and Coblentz, 1929). Reflectance of a single leaf is low in the visible region of the spectrum due to absorption by plant pigments and high in the near-infrared due to internal leaf scattering and lack of absorption by chlorophyll and water (Knipling, 1970). Reflectance of an entire plant or branch will vary with leaf orientation, shadows, and background. Absorption by water results in low reflectivity beyond 1.2 μm . Major water absorption bands are present at 1.4 μm and 1.9 μm , but are not recorded in the field spectra because of atmospheric absorption; minor water bands at 0.76 μm , 0.97 μm , 1.19 μm , and 2.1 μm are more apparent in some spectra (fig. 89) than in others (fig. 8). The erratic oscillations which often occur at 0.95 μm and 1.14 μm are also due to atmospheric water conditions. Other oscillations occur due to noise superimposed on the reflectance spectra, and should not be interpreted as real data.

Detailed analysis of these spectra is being conducted in conjunction with analysis of the mineralogical and chemical composition of the host rocks and soils. The results will be reported in subsequent reports.

Acknowledgement

The Portable Field Reflectance Spectrometer (PFRS) was made available by the Jet Propulsion Laboratory, California Institute of Technology, as part of research under Contract Number NAS 7-1000 with the National Aeronautics and Space Administration (NASA).

D. Arias reduced the spectral data.

mineral, and alunite contents of hydrothermally altered rocks in the Caprite mining district, Nevada, using aircraft imagery for the 0.45-2.35 μ m spectral region: *Geol. Soc. Am. abstracts with programs*, 3(7), p. 843.

Billings, W. D., 1950, Vegetation and plant growth as affected by chemically altered rocks in the Western Great Basin: *Ecology*, vol. 31, p. 62-74.

Billings, W. D., and Davis, R. J., 1954, Reflection of visible and infrared radiation from leaves of different vegetation types: *Amer. Jour. Botany*, vol. 41, p. 37-48.

Blodgett, W. N., Brown, G. P., and Dyke, J. C., 1967, *Aerial mapping in northern Arizona*. Report of the U.S. Geological Survey, Techniques: NASA Tech. Rep. No. 67-1.

Caney, F. C., Wenderoth, J. M., and Davis, R. J., 1967, Relationship between vegetation reflectance and soil moisture: *Soil Sci. Soc. Am. Proc.*, vol. 31, p. 10-13-14.

New Data from Earth Resources Program: *Earth Resources Program Report*, vol. 1, p. 10-13-14.

References Cited

- Abrams, M. J., Ashley, R. G., Rowan, L. C., Goetz, A. F. H., and Kahle, A. B., 1977, Use of imaging in the 0.46-2.36 μm spectral region for alteration mapping in the Cuprite mining district, Nevada: U.S. Geol. Survey Open-File Rept. 77-585, 19 p.
- Ashley, R. P., and Abrams, M. J., 1977, Mapping of limonite, clay mineral, and alunite contents of hydrothermally altered rocks in the Cuprite mining district, Nevada, using aircraft scanner imagery for the 0.46-2.36 μm spectral region: Geol. Soc. Amer. abstracts with programs, 9(7), p. 883.
- Billings, W. D., 1950, Vegetation and plant growth as affected by chemically altered rocks in the western Great Basin: Ecology, vol. 31, p. 62-74.
- Billings, W. D., and Morris, R. J., 1951, Reflection of visible and infrared radiation from leaves of different ecological groups: Amer. Jour. Botany, vol. 38, p. 327-331.
- Blodgett, H. W., Brown, G. F., and Moik, J. G., 1975, Geological mapping in northwestern Saudi Arabia using Landsat multispectral techniques: NASA Tech. Doc. No. X-923-75-206, 21 p.
- Canney, F. C., Wenderoth, Sondra, and Yost, Edward, 1970, Relationship between vegetation reflectance spectra and soil geochemistry - New data from Catheart Mountain, Maine, in Third Annual Earth Resources Program Review: Geol. and Geography, vol. 1, p. 18-1-18-9.

- Curcio, J. A., and Petty, C. C., 1951, The near-infrared absorption of liquid water: Jour. Opt. Soc. Amer., vol. 41, p. 302-304.
- Cates, D. M., 1962, Energy Exchange in the Biosphere: Harper and Row, New York, 151 p.
- Gates, D. M., and Tantraporn, W., 1952, The reflectivity of deciduous trees and herbaceous plants in the infrared to 25 microns: Science, vol. 115, p. 613-616.
- Goetz, A. F. H., Billingsley, F. C., Gillespie, A. R., Abrams, M. J., Squires, R. R., Shoemaker, E. M., Lucchitta, I., and Elston, D. P., 1975, Application of ERTS images and image processing to regional geologic problems and geologic mapping in northern Arizona: NASA Tech. Rept. 32-1597, 188 p.
- Howard, J. A., Watson, R. D., and Hessin, T. D., 1971, Spectral reflectance properties of Pinus ponderosa in relation to copper content of the soil, Malachite Mine, Jefferson County, Colorado, in Symposium on Remote Sensing of Environment: Proc. of 7th Ann. Mtg., Ann Arbor, Michigan, p. 285-296.
- Knipling, E. B., 1970, Physical and physiological basis for the reflectance of visible and near-infrared radiation from vegetation: Remote Sensing of Environment, vol. 1(3), p. 155-159.
- Lag, J., and Bolviken, B., 1974, Some naturally heavy-metal poisoned areas of interest in prospecting, soil geochemistry, and geo-medicine: Norges Geol. Unders., vol. 304, p. 73-96.

- Lovering, T. S., 1949, Rock alteration as a guide to ore, East Tintic district, Utah: Econ. Geol. Monograph 1, 64 p.
- Lyon, R. J. P., 1975, Correlation between ground metal analysis, vegetation reflectance, and ERTS brightness over a molybdenum skarn deposit, Pine Nut Mountains, western Nevada, in Proceedings of 10th International Symposium on Remote Sensing of Environment: Ann Arbor, Michigan.
- Morris, H. T., 1957, General Geology of the East Tintic Mountains, Utah, in Geology of the East Tintic Mountains and ore deposits of the Tintic mining district: Utah Geol. Soc. Guidebook to Geol. of Utah, no. 12, p. 1-56.
- Morris, H. T., 1964a, Geology of the Tintic Junction quadrangle, Tooele, Juab, and Utah Counties, Utah: U.S. Geol. Survey Bull. 1142-L, 23 p.
- Morris, H. T., 1964b, Geology of the Eureka quadrangle, Utah and Juab Counties, Utah: U.S. Geol. Survey Bull. 1142-K, 29 p.
- Morris, H. T., 1975, Geologic map and sections of the Tintic Mountain quadrangle and adjacent part of the McIntyre quadrangle, Juab and Utah Counties, Utah: U.S. Geol. Survey Misc. Inves. Map I-883.
- Morris, H. T., and Lovering, T. S., 1961, Stratigraphy of the East Tintic Mountains, Utah, with a section on Quarternary deposits by H. D. Goode: U.S. Geol. Survey Prof. Paper 361, 12 p.
- Moss, R. A., and Loomis, W. E., 1952, Absorption spectra of leaves - I - The visible spectrum: Plant Physiol., vol. 27, p. 370-391.

- Offield, T. W., 1976, Remote sensing in uranium exploration: Amer. Inst. Min. Engr. (AIME) Proc. of Mtg, 30 March-2 April 1976, Vienna, Austria, p. 731-744.
- Pearson, R. L., Tucker, C. J., and Miller, L. D., 1976, Spectral mapping of shortgrass prairie biomass: Photo. Engr. and Remote Sensing, vol. 42(3), p. 317-323.
- Raines, G. L., and Canney, F. C., in press, Vegetation and geology, in Remote Sensing and Geology: Siegal, B.S., and Gillespie, A.R., eds.
- Rowan, L. C., Wetlaufer, P. H., Goetz, A. F. H., Billingsley, F. C., and Stewart, J. H., 1974, Discrimination of rock types and detection of hydrothermally altered areas in south-central Nevada by use of computer-enhanced ERTS images: U.S. Geol. Survey Prof. Paper 883, 35 p.
- Rowan, L. C., Goetz, A. F. H., and Ashley, R. P., 1977, Discrimination of hydrothermally altered and unaltered rocks in visible and near-infrared multispectral images: Geophysics. vol. 42(3), p. 522-535.
- Salisbury, F. B., 1964, Soil formation and vegetation on hydrothermally altered rock material in Utah: Ecology, vol. 45, p. 1-9.
- Shull, C. A., 1929, A spectrophotometric study of reflection of light from leaf surfaces: Botanical Gazette, vol. 87, p. 583-607.

- Siegal, B. S., and Goetz, A. F. H., 1977, Effect of vegetation on rock and soil type discrimination: Photo. Engr. and Remote Sensing, vol. 42(3), p. 191-196.
- Stair, R., and Coblentz, W. W., 1929, The infrared absorption spectrum of chlorophyll and xanthophyll: Phys. Rev., vol. 33, p. 1092.
- Vincent, R. K., 1977, Uranium exploration with computer-processed Landsat data: Geophysics, vol. 42(3), p. 536-541.

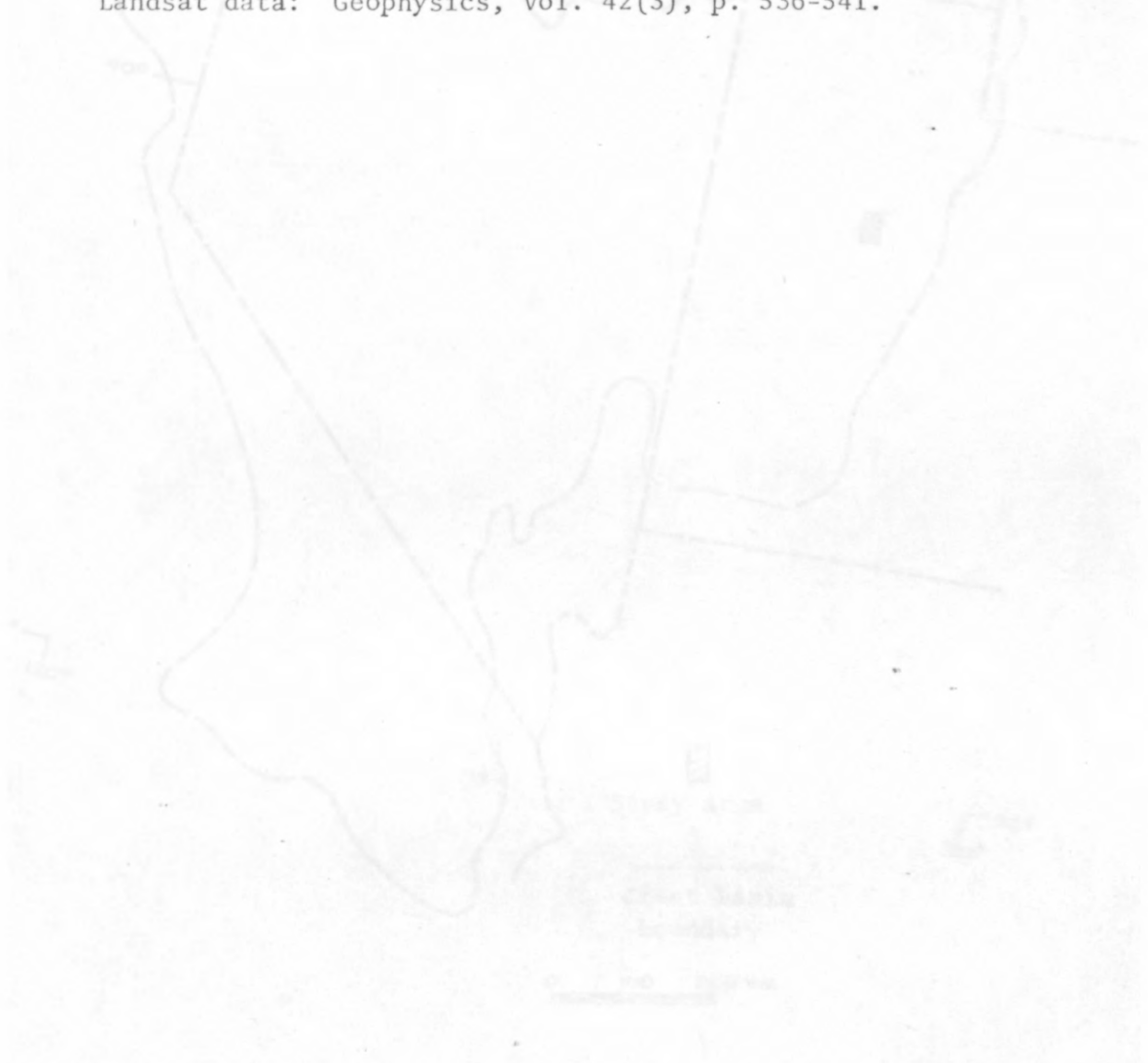


Fig. 1. Location of the study area.

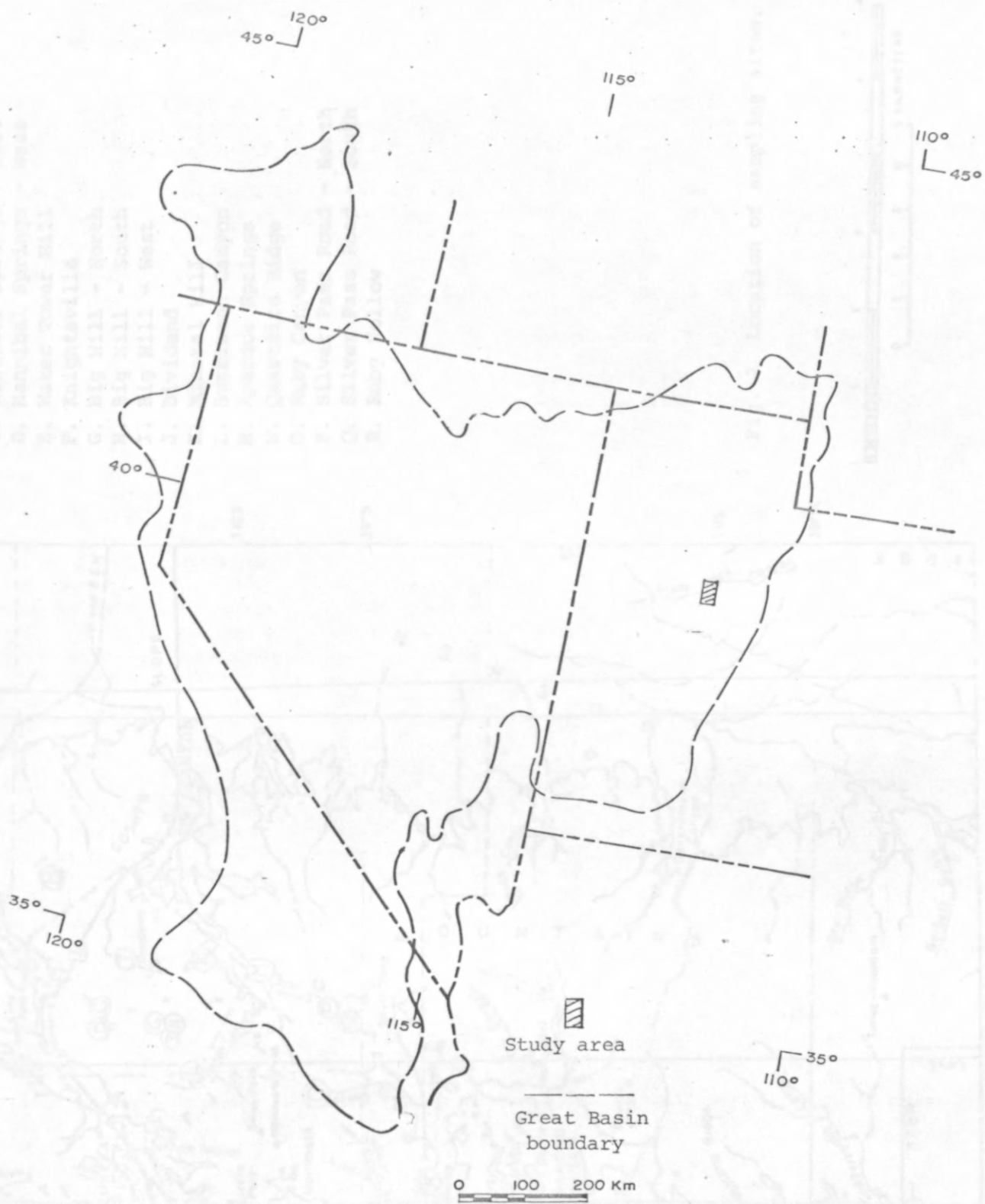
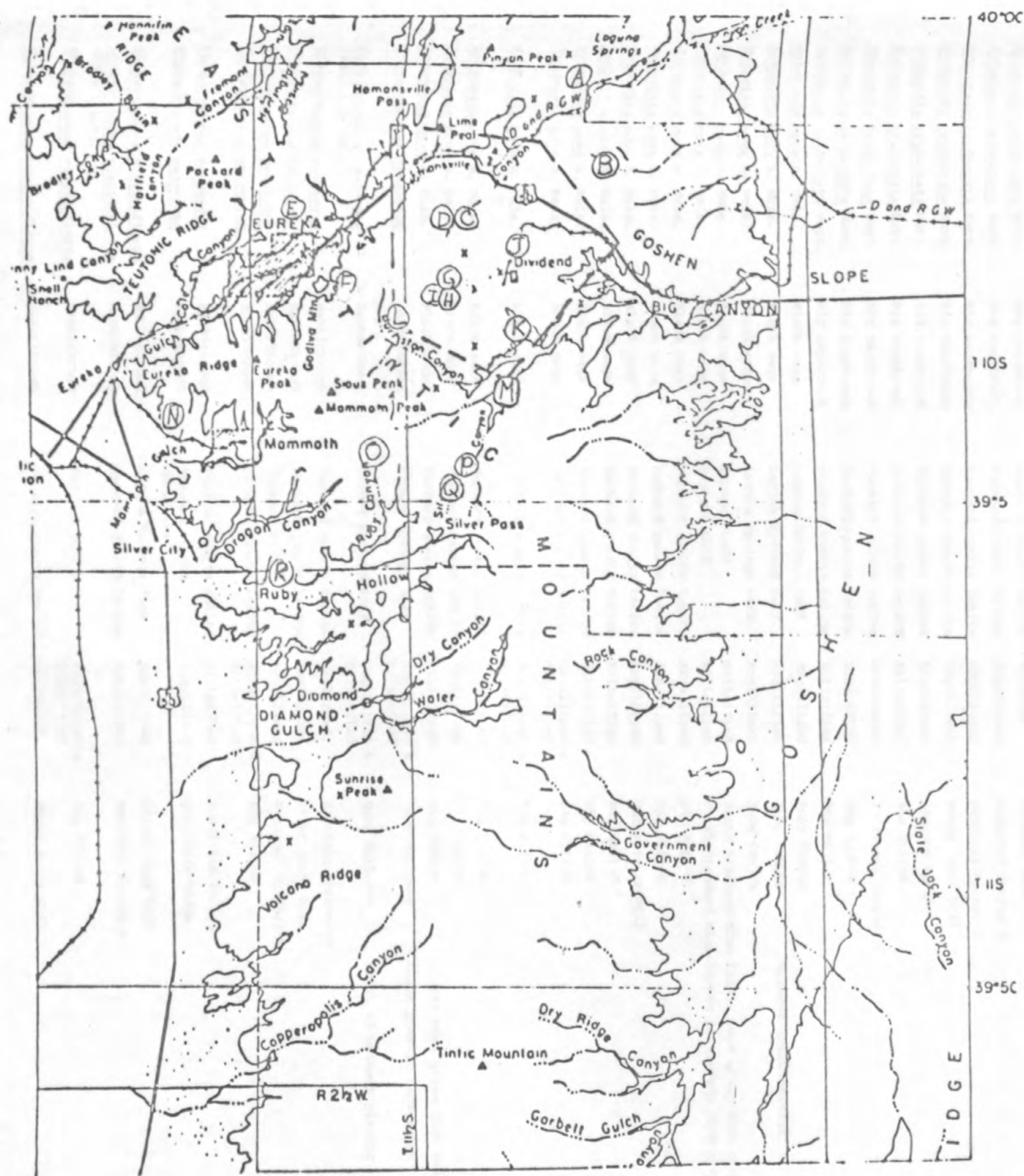


Fig. 1 Location of the study area.



- A. North Standard Mine
- B. Independence Shaft
- C. Hannibal Springs - East
- D. Hannibal Springs - West
- E. Water Tower Hill
- F. Knightsville
- G. Big Hill - North
- H. Big Hill - South
- I. Big Hill - West
- J. Dividend
- K. Mineral Hill
- L. Burraston Canyon
- M. Aperdue Springs
- N. Quartzite Ridge
- O. Ruby Canyon
- P. Silver Pass Road - North
- Q. Silver Pass Road - South
- R. Ruby Hollow

Fig. 2 Location of sampling sites.

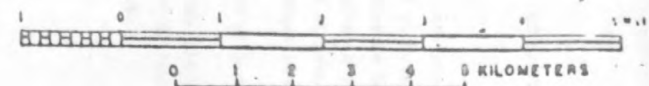
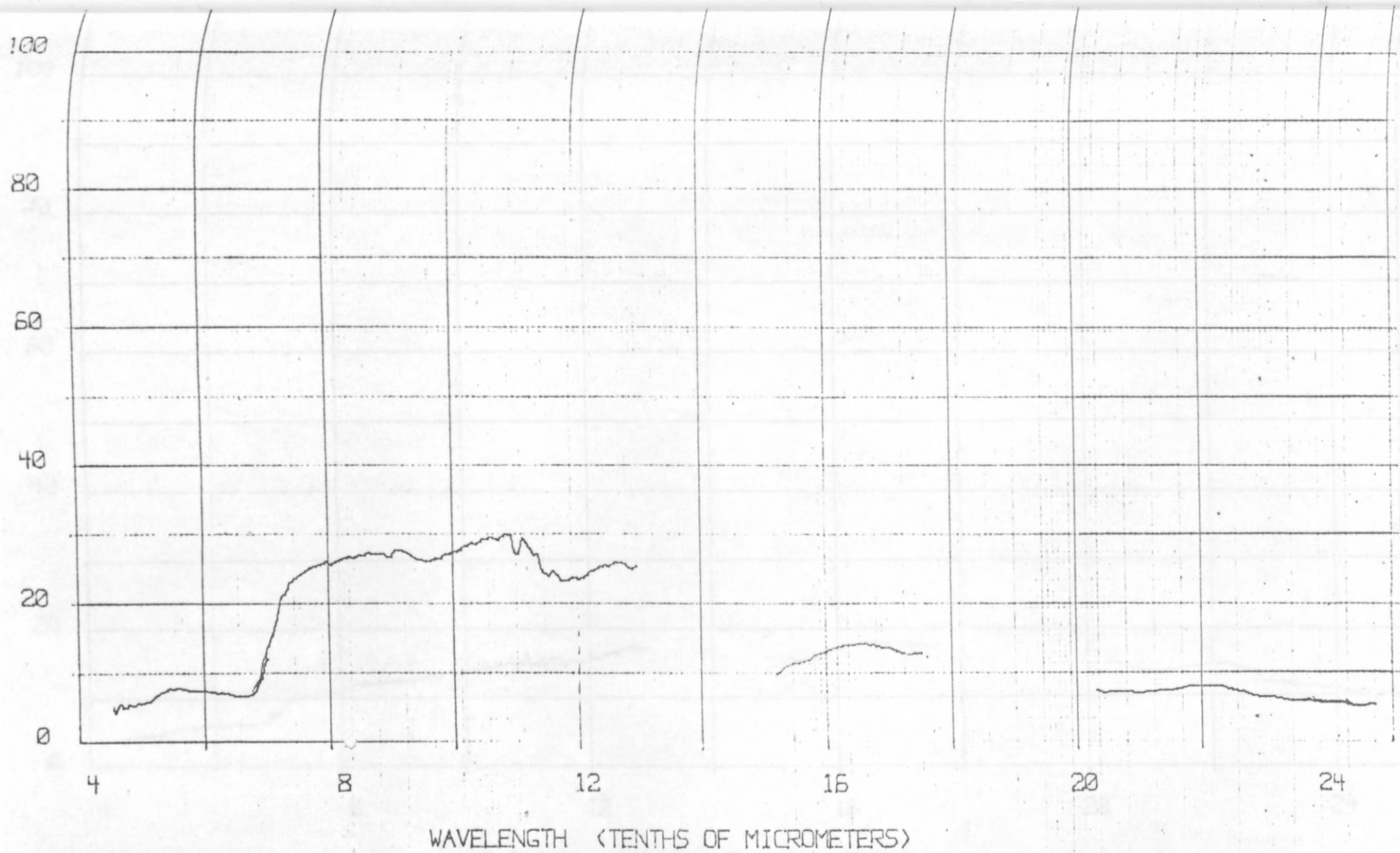


Figure	Scientific Name	Common Name	Formation	Alteration	Location	Additional Comments
3	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs flow	Unaltered	Silver Pass Rd-N	
4	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Silicified	Ruby Hollow-E	
5	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Silicified	Ruby Hollow-E	Dead; black plastic background
6	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Silicified	Ruby Hollow-E	Shrub 5 without plastic
7	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Silicified	Ruby Hollow-E	Black plastic background
8	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Silicified	Ruby Hollow-E	Black plastic background
9	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Silicified	Ruby Hollow-E	Shrub 8 without plastic
10	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Argillized & Silicified	Ruby Hollow-W	Dead; black plastic background
11	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Argillized & Silicified	Ruby Hollow-W	Shrub 10 without black plastic
12	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Silicified	Ruby Hollow-E	Half dead; black plastic background
13	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Laguna Springs tuff	Silicified	Ruby Hollow-E	Shrub 12 without plastic
14	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard tuff	Silicified	North Standard Mine	1/4 dead
15	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard tuff	Silicified	North Standard Mine	
16	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Unaltered	Hannibal Spring-W	
17	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Unaltered	Water tower hill	
18	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard tuff	Calclitic	Dividend	
19	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Pyritic	Knightsville	
20	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Argillized	Hannibal Spring-E	
21	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Argillized	Hannibal Spring-E	
22	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Argillized	Water tower hill	
23	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Argillized	Aperdue Spring	Small
24	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Silicified	Big Hill-S	
25	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Silicified	Burrison Canyon	
26	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Silicified	Big Hill-N	
27	<u>Artemisia tridentata</u> Nutt.	Big sagebrush	Packard quartz latite	Silicified	Big Hill-S	
28	<u>Artemisia nova</u> A. Nels.	Black sage	Laguna Springs tuff	Argillized	Ruby Canyon	
29	<u>Artemisia nova</u> A. Nels.	Black sage	Laguna Springs tuff	Argillized	Ruby Canyon	Without inflorescence
30	<u>Artemisia nova</u> A. Nels.	Black sage	Laguna Springs tuff	Argillized	Ruby Canyon	
31	<u>Artemisia nova</u> A. Nels.	Black sage	Packard tuff	Silicified	North Standard Mine	Leaves more green than gray
32	<u>Artemisia nova</u> A. Nels.	Black sage	Packard tuff	Silicified	North Standard Mine	Leaves more green than gray
33	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Argillized	Big Hill-W	
34	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Argillized	Big Hill-W	
35	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Argillized	Water tower Hill	
36	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Silicified	Big Hill-S	
37	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Silicified	Big Hill-S	
38	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Artillized & Silicified	Big Hill-N	
39	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Argillized & Silicified	Big Hill-N	
40	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Silicified	Big Hill-N	
41	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Silicified	Big Hill-N	
42	<u>Artemisia nova</u> A. Nels.	Black sage	Packard quartz latite	Silicified	Big Hill-N	Leaves more green than gray
43	<u>Chrysothamnus nauseosus</u>	Rabbitbrush	Laguna Springs tuff	Argillized & Silicified	Ruby Hollow-W	Black plastic background
44	<u>Chrysothamnus nauseosus</u> (Pall.) Britt.	Rabbitbrush	Laguna Springs tuff	Argillized & Silicified	Ruby Hollow-W	Shrub 43 without plastic
45	<u>Chrysothamnus nauseosus</u>	Rabbitbrush	Packard quartz latite	Unaltered	Hannibal Springs-W	
46	<u>Chrysothamnus nauseosus</u>	Rabbitbrush	Packard quartz latite	Unaltered	Water tower hill	
47	<u>Chrysothamnus nauseosus</u>	Rabbitbrush	Packard tuff	Argillized	Hannibal Springs-E	
48	<u>Chrysothamnus nauseosus</u>	Rabbitbrush	Packard quartz latite	Argillized & Silicified	Big Hill-N	
49	<u>Chrysothamnus nauseosus</u>	Rabbitbrush	Packard quartz latite	Silicified	Burrison Canyon	
50	<u>Chrysothamnus nauseosus</u>	Rabbitbrush	Swansea quartz monzonite	Argillized	Quartzite Ridge	
51	<u>Chrysothamnus viscidiflorus</u>	Rabbitbrush	Laguna Springs flow	Argillized	Silver Pass Rd-S	
52	<u>Chrysothamnus viscidiflorus</u> (Hook.) Nutt.	Rabbitbrush	Packard quartz latite	Argillized	Hannibal Spring-E	
53	<u>Chrysothamnus viscidiflorus</u>	Rabbitbrush	Packard tuff	Argillized & Silicified	Big Hill-N	
54	<u>Chrysothamnus viscidiflorus</u>	Rabbitbrush	Packard quartz latite	Unaltered	Water tower hill	

Core	Scientific Name	Common Name	Formation	Alteration	Location	Additional Comments
55	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Laguna Springs tuff	Argillized & Silicified	Ruby Hollow-W	Black plastic background
56	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Laguna Springs tuff	Argillized & Silicified	Ruby Hollow-W	Shrub 55 without plastic
57	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Packard tuff	Argillized	North Standard Mine	
58	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Packard quartz latite	Unaltered	Hannibal Spring-W	
59	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Packard quartz latite	Unaltered	Water tower hill	
60	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Packard tuff	Calcitic	Dividend	
61	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Silver City porphyry	Argillized	Hannibal Spring-E	Low spreading bush
62	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Packard quartz latite	Argillized	Hannibal Spring-E	Tall lush bush
63	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Packard quartz latite	Argillized	Aperdue Spring	
64	<i>Purshia tridentata</i> (Pursh) DC	Antelope brush	Packard quartz latite	Argillized & Silicified	Big Hill-W	
65	<i>Ephedra viridis</i> Coville	Mormon tea	Packard tuff	Silicified	North Standard Mine	
66	<i>Ephedra viridis</i> Coville	Mormon tea	Packard tuff	Unaltered	Independence Shaft	
67	<i>Ephedra viridis</i> Coville	Mormon tea	Packard tuff	Calcitic	Dividend	
68	<i>Ephedra viridis</i> Coville	Mormon tea	Packard quartz latite	Argillized	Hannibal Spring-E	
69	<i>Tetradymia glabrata</i> Gray	Horsebrush	Packard tuff	Unaltered	Independence Shaft	
70	<i>Gutierrezia sarathroe</i> (Pursh) Britt. & Rusby	Snakeweed	Packard quartz latite	Unaltered	Hannibal Spring-W	
71	<i>Gutierrezia sarathroe</i>	Snakeweed	Packard quartz latite	Silicified	Burrison Canyon	
72	<i>Petrorhiza pumila</i> (Nutt.) Greene	Rock goldenrod	Packard tuff	Argillized	North Standard Mine	
73	<i>Haplopappus acaulis</i> (Nutt.) Gray	Cushion stenotus	Packard quartz latite	Argillized	Big Hill-W	
74	<i>Opuntia</i> Mill.	Prickly pear	Packard quartz latite	Unaltered	Hannibal Spring-W	
75	<i>Opuntia</i> Mill.	Prickly pear	Packard quartz latite	Argillized	Water tower hill	
76	<i>Cowania mexicana</i> D. Don	Cliffrose	Herkimer dolomite	Unaltered	Mineral Hill	Vertical view
77	<i>Cowania mexicana</i> D. Don	Cliffrose	Herkimer dolomite	Unaltered	Mineral Hill	Shrub 76, 45° from vertical
78	<i>Cowania mexicana</i> D. Don	Cliffrose	Herkimer dolomite	Unaltered	Mineral Hill	Shrub 76, 60° from vertical
79	<i>Cowania mexicana</i> D. Don	Cliffrose	Packard tuff	Argillized	North Standard Mine	
80	<i>Cowania mexicana</i> D. Don	Cliffrose	Packard tuff	Argillized	North Standard Mine	Shrub 79 again
81	<i>Cercocarpus montanus</i> Raf.	Mountain mahogany	Packard quartz latite	Argillized	Big Hill-W	
82	<i>Juniperus osteosperma</i> (Torr.) Little	Utah juniper	Laguna Springs flow	Argillized	Silver Pass Rd-S	Young tree
83	<i>Juniperus osteosperma</i>	Utah juniper	Laguna Springs tuff	Silicified	Ruby Hollow-E	Black plastic background
84	<i>Juniperus osteosperma</i>	Utah juniper	Laguna Springs tuff	Silicified	Ruby Hollow-E	Shrub 83 without plastic
85	<i>Juniperus osteosperma</i>	Utah juniper	Laguna Springs tuff	Argillized & Silicified	Ruby Hollow-W	Side branch with black plastic
86	<i>Juniperus osteosperma</i>	Utah juniper	Laguna Springs tuff	Argillized & Silicified	Ruby Hollow-W	Shrub 85 without plastic
87	<i>Juniperus osteosperma</i>	Utah juniper	Packard tuff	Silicified	North Standard Mine	
88	<i>Juniperus osteosperma</i>	Utah juniper	Packard quartz latite	Pyritic	Knightsville	Lower branch
89	<i>Juniperus osteosperma</i>	Utah juniper	Packard quartz latite	Argillized	Hannibal Spring-E	Side branch
90	<i>Pinus monophylla</i> Torr & Frem.	Singleleaf pinyon	Packard tuff	Silicified	North Standard Mine	
91	<i>Pinus monophylla</i>	Singleleaf pinyon	Packard tuff	Calcitic	Dividend	
92	<i>Pinus monophylla</i>	Singleleaf pinyon	Packard quartz latite	Argillized	Hannibal Spring-E	
93	<i>Pinus monophylla</i>	Singleleaf pinyon	Packard tuff	Argillized	Hannibal Spring-E	
94	<i>Pinus monophylla</i>	Singleleaf pinyon	Packard quartz latite	Argillized	Big Hill-W	
95	<i>Pinus monophylla</i>	Singleleaf pinyon	Packard quartz latite	Argillized	Aperdue Spring	
96	<i>Pinus monophylla</i>	Singleleaf pinyon	Tintic quartzite	Unaltered	Quartzite Ridge	
97	<i>Acer grandidentatum</i> Nutt.	Big tooth maple	Packard quartz latite	Argillized & Silicified	Big Hill-N	
98	<i>Oryzopsis hymenoides</i> (R&S) Riker	Indian ricegrass	Packard quartz latite	Unaltered	Hannibal Spring-W	
99		Grass	Packard quartz latite	Unaltered	Hannibal Spring-W	
100		Grass	Packard quartz latite	Argillized	Water tower hill	Half dry
101		Black plastic bag				



WAVELENGTH (TENTHS OF MICROMETERS)

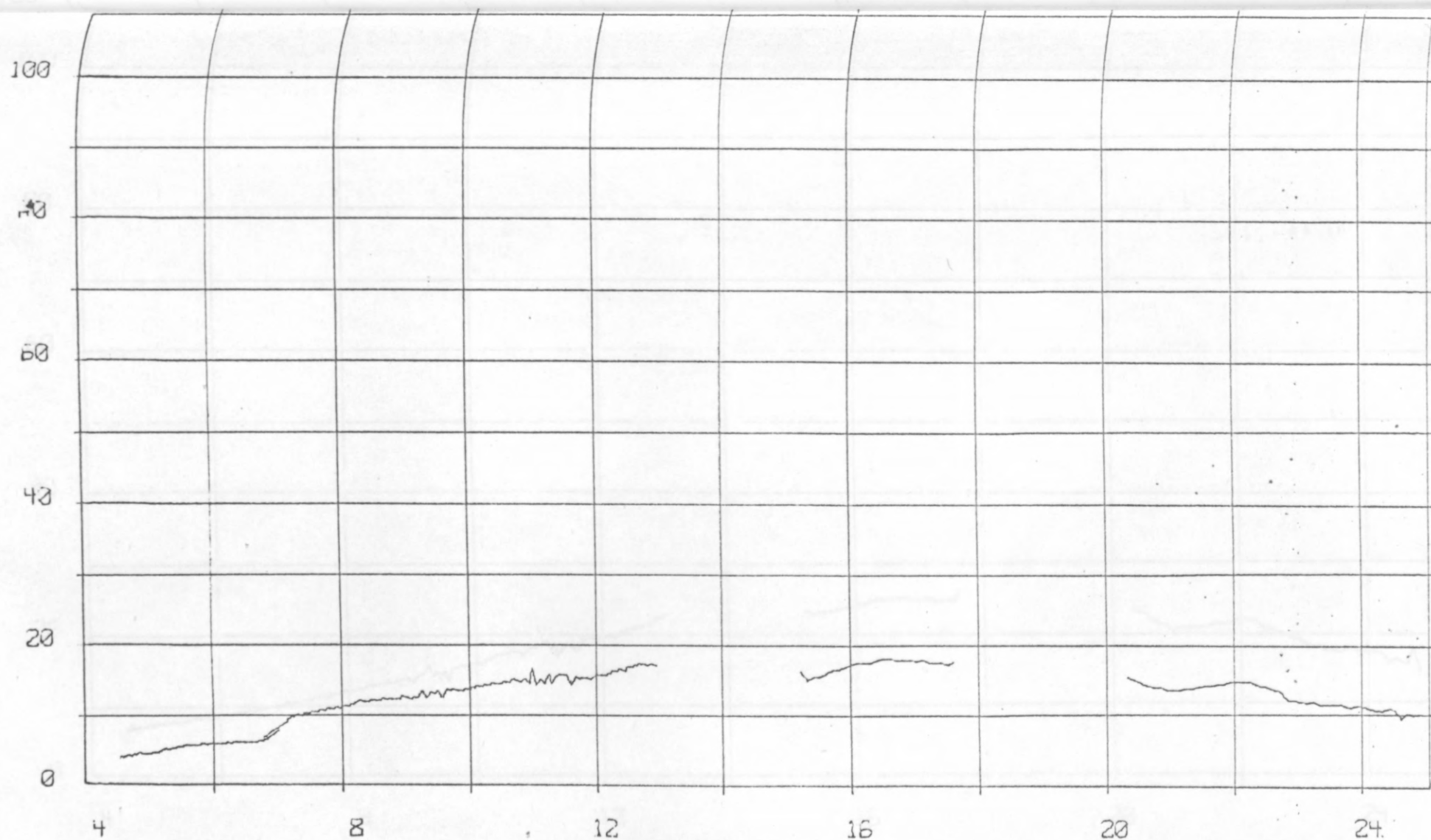
9 AUG '77

TINTIC, UTAH, TAPE ⁹(~~10~~) SITE: E-67/ULS-BIG SAGE

065/067

ABSOLUTE REFLECTANCE

Fig. 3 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

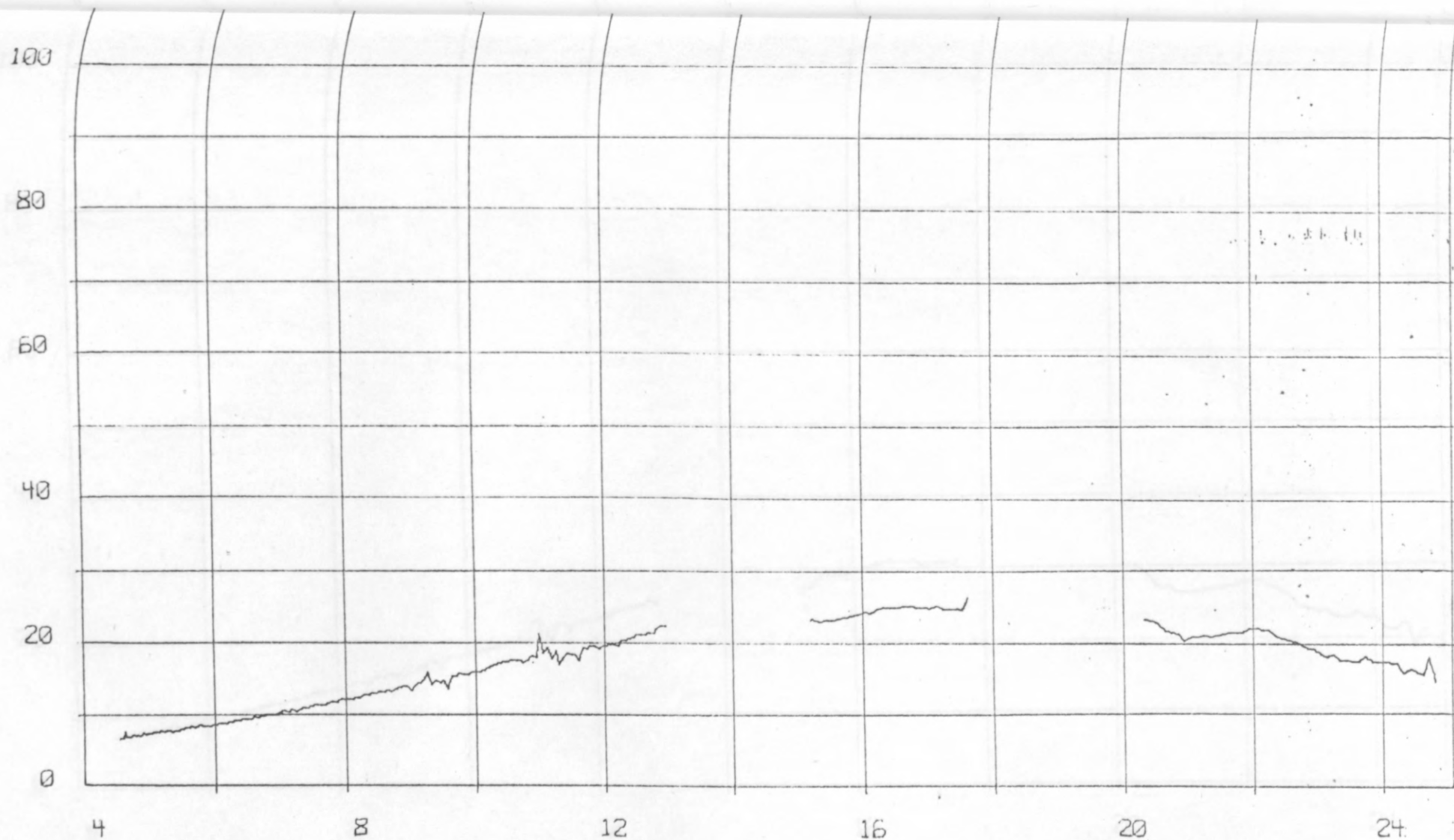
5 AUG 77

TINTIC, UTAH, TAPE (2) SITE: C-22/BIG SAGE W/OHB

074/075

ABSOLUTE REFLECTANCE

Fig. 4 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

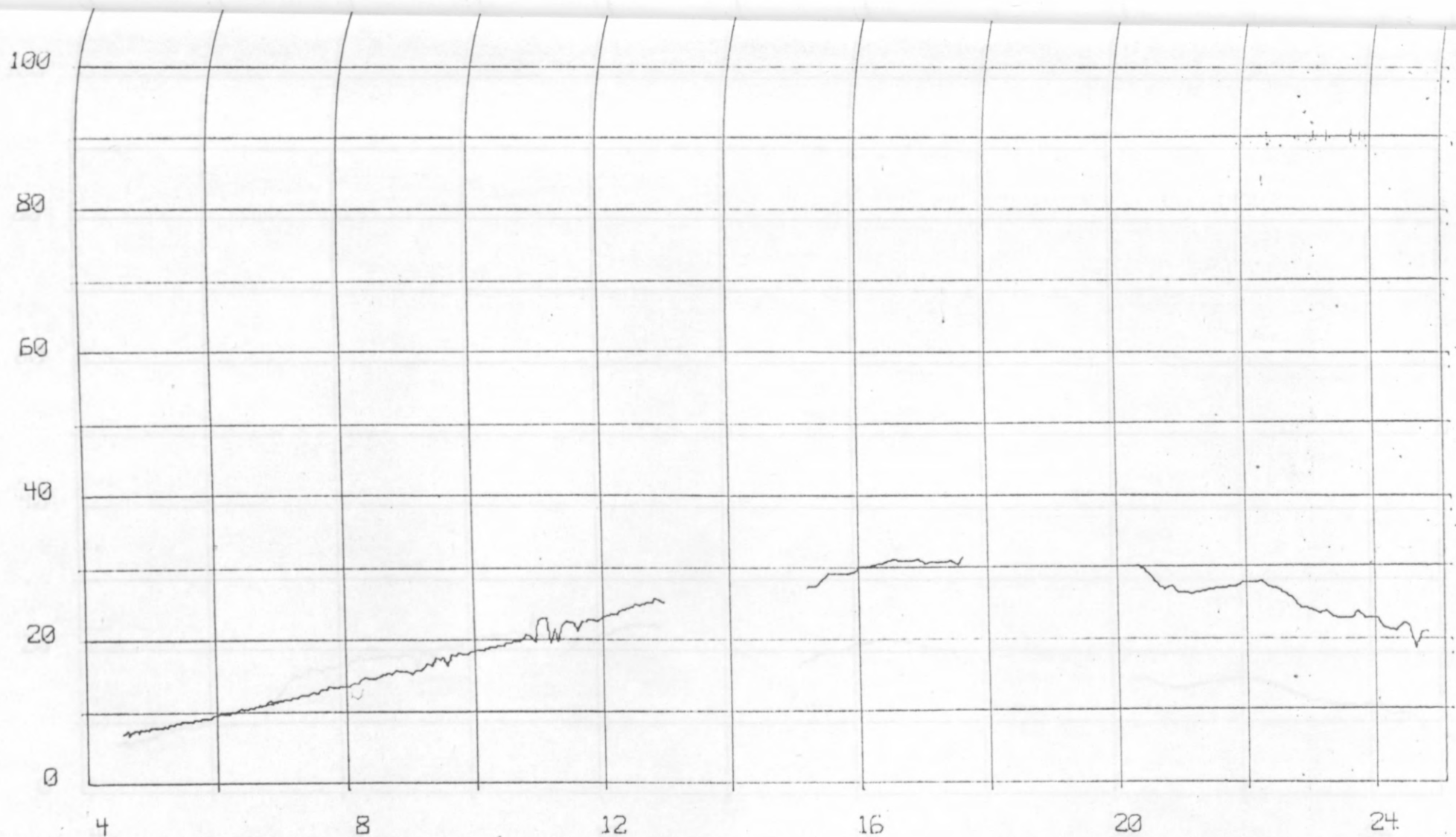
5 AUG 77

TINTIC, UTAH, TAPE (2) SITE: C-17/DEAD SAGE W/HB

055/057

ABSOLUTE REFLECTANCE

Fig. 5 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

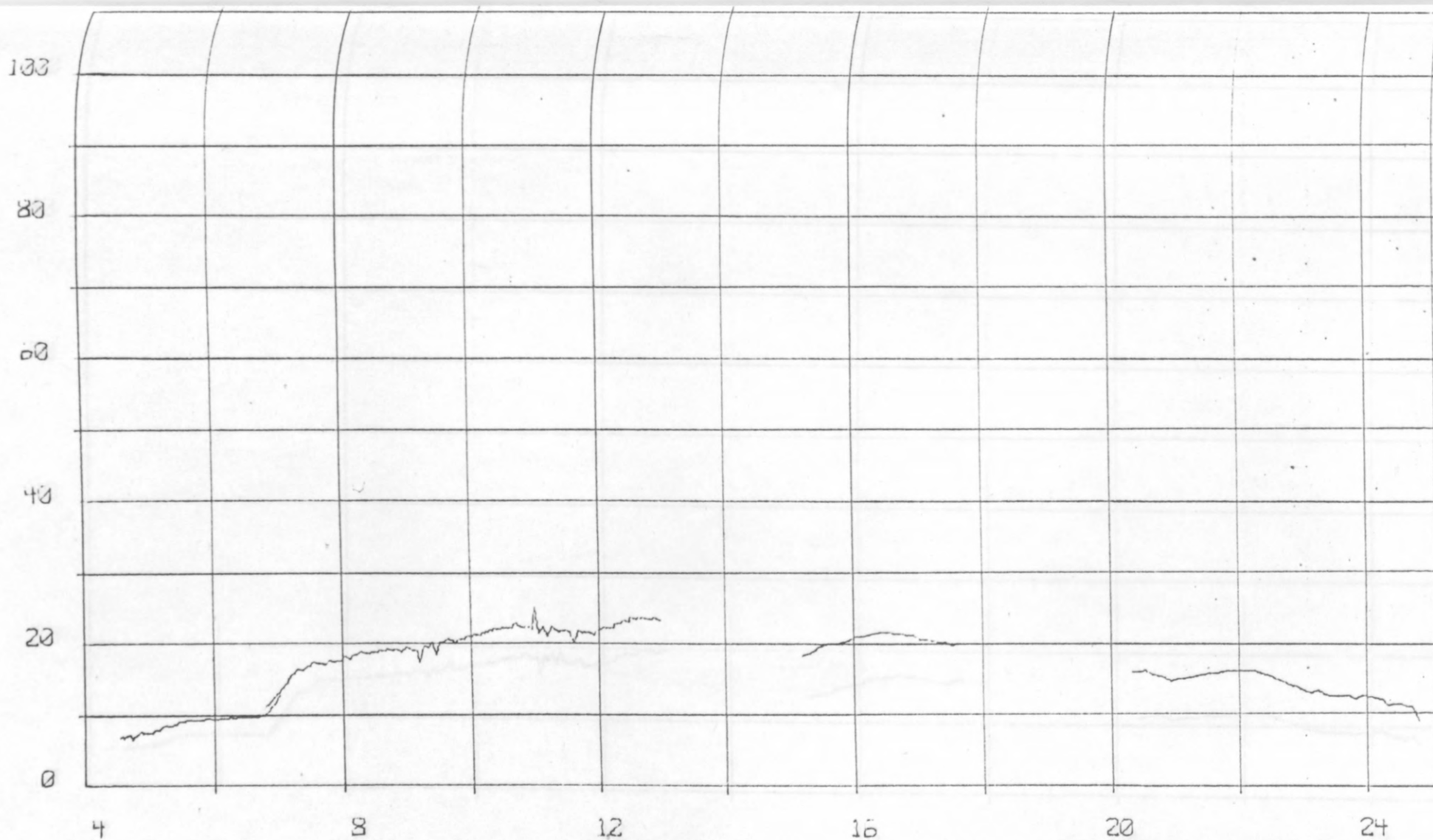
5 AUG 77

TINTIC, UTAH, TAPE (2) SITE: C-17/DEAD SAGE W/OH

056/057

ABSOLUTE REFLECTANCE

Fig. 6 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

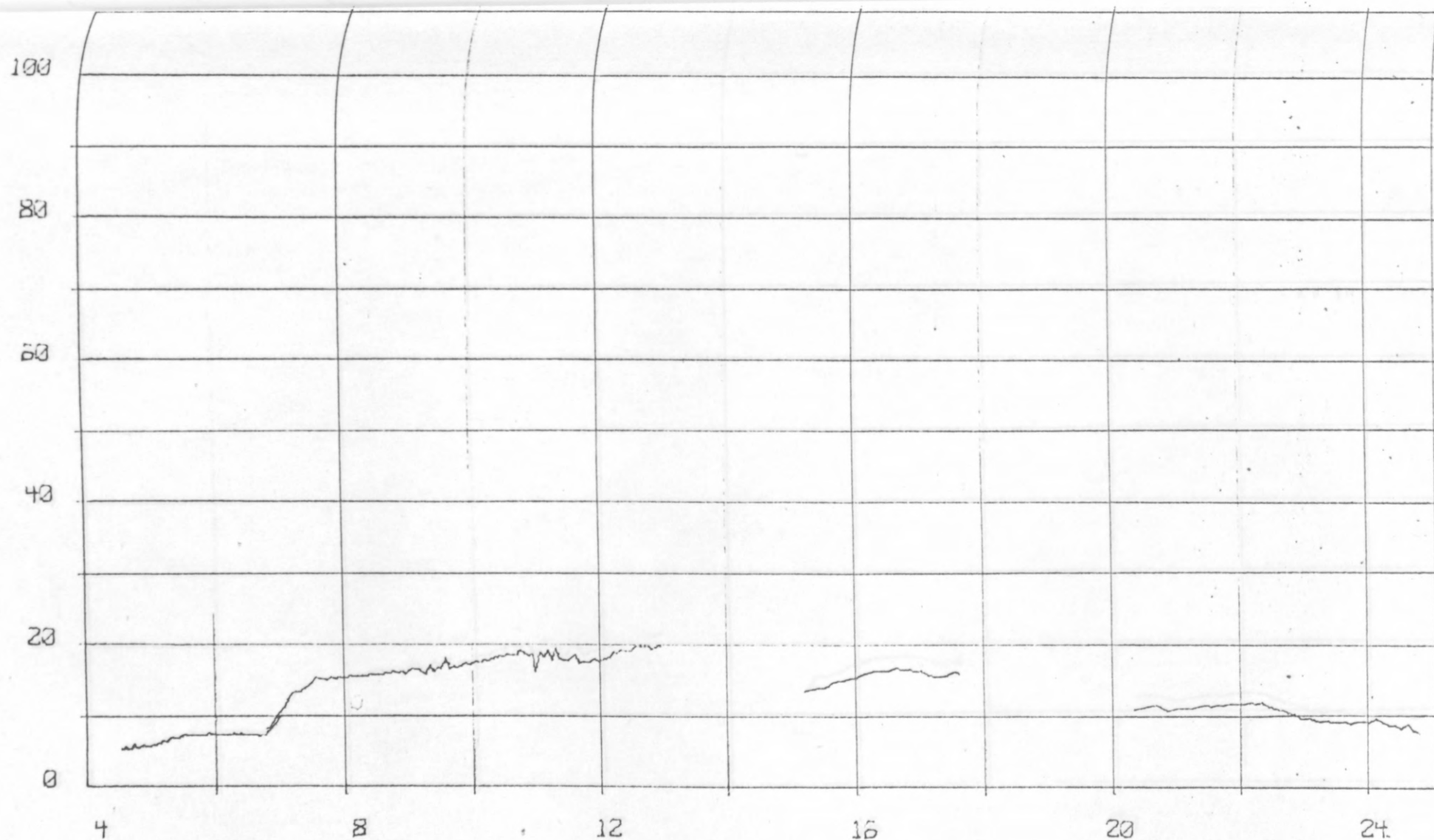
5 AUG 77

TINTIC, UTAH, TAPE (2) SITE: C-29/SAGE W/HB

123/124

ABSOLUTE REFLECTANCE

Fig. 7 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

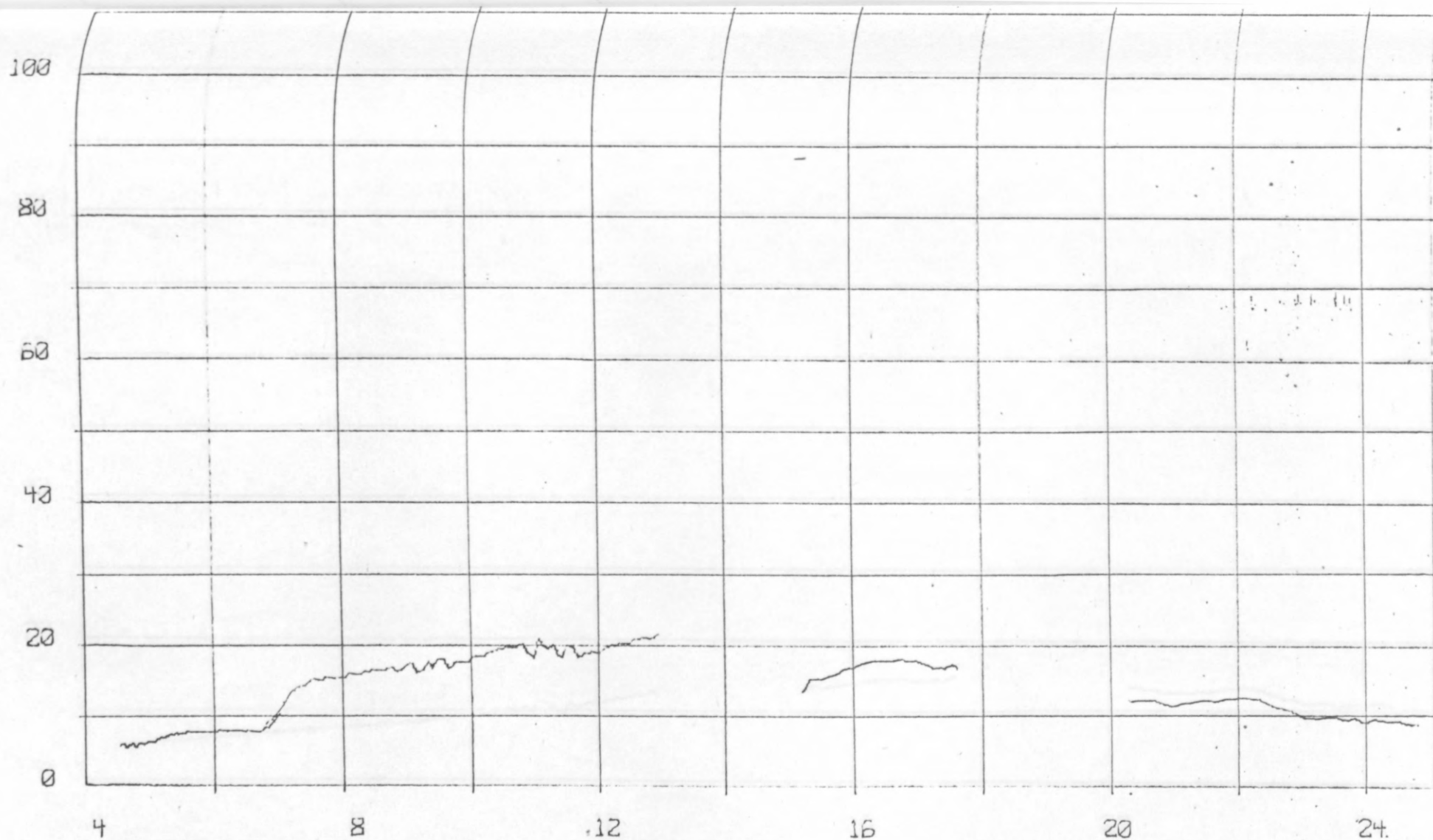
5 AUG 77

TINTIC, UTAH. TAPE (2) SITE: C-32/BIG SAGE W/HB

136/137

ABSOLUTE REFLECTANCE

Fig. 8 *Artemisia tridentata*



WAVELENGTH (TENTHS OF MICROMETERS)

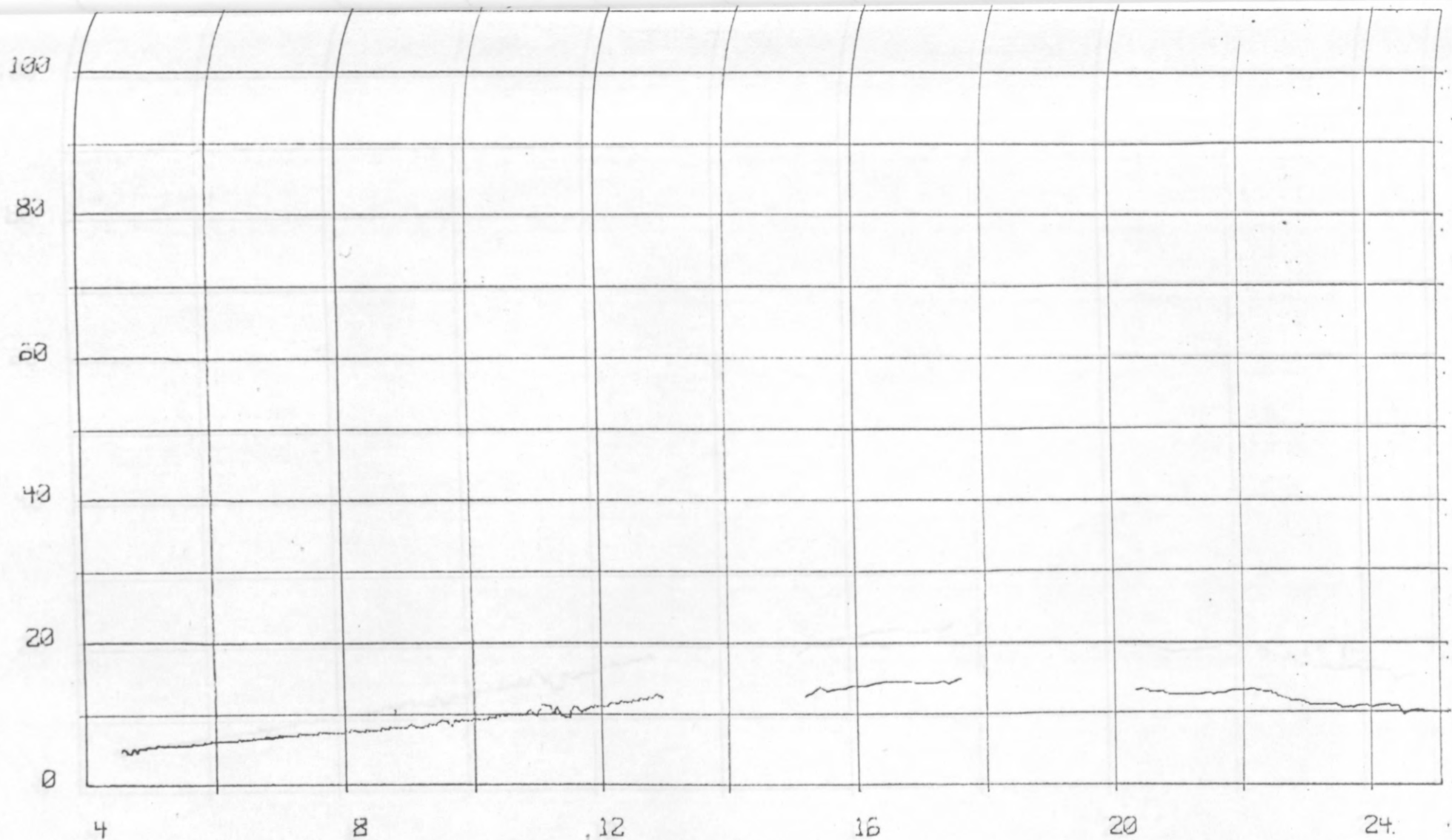
5 AUG 77

TINTIC, UTAH. TAPE (2) SITE: C-32/SOB W/OHB

140/137

ABSOLUTE REFLECTANCE

Fig. 9 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

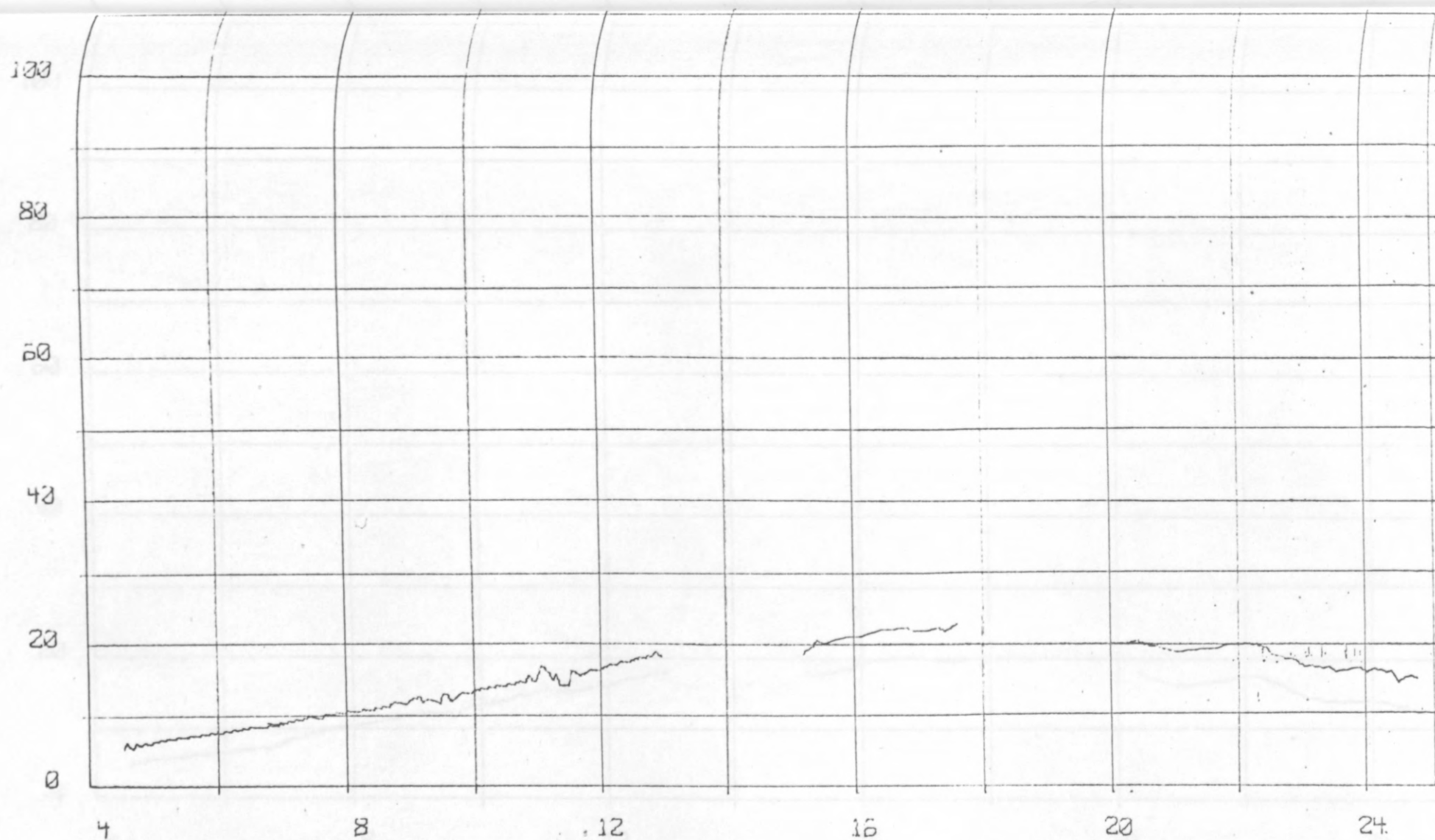
5 AUG 77

TINTIC, UTAH. TAPE (2) SITE: D-37/DEAD SAGE W/HB

153/154

ABSOLUTE REFLECTANCE

Fig. 10 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

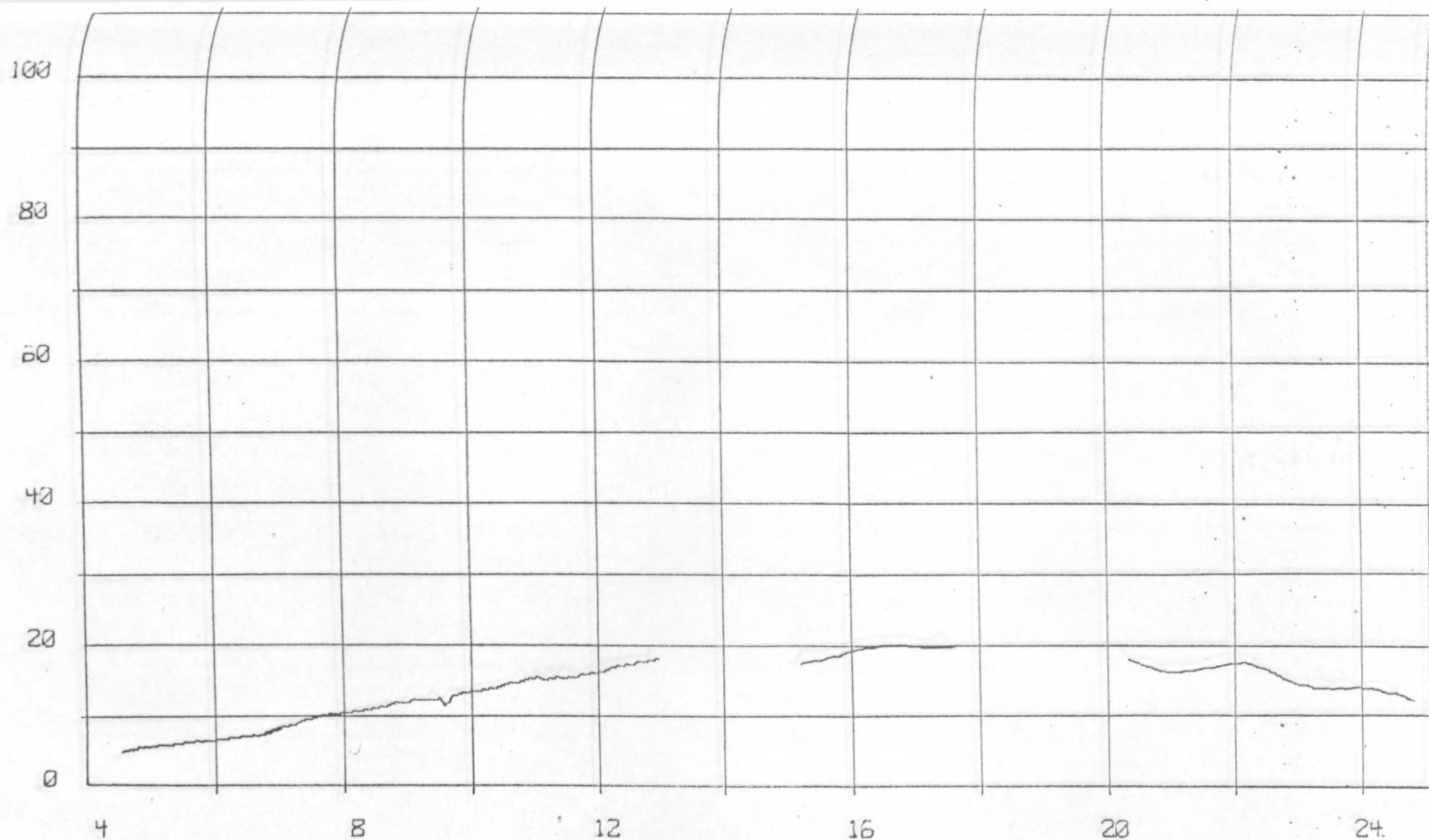
5 AUG 77

TINTIC, UTAH, TAPE (2) SITE: D-37/DEAD SAGE W/OH

155/154

ABSOLUTE REFLECTANCE

Fig. 11 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

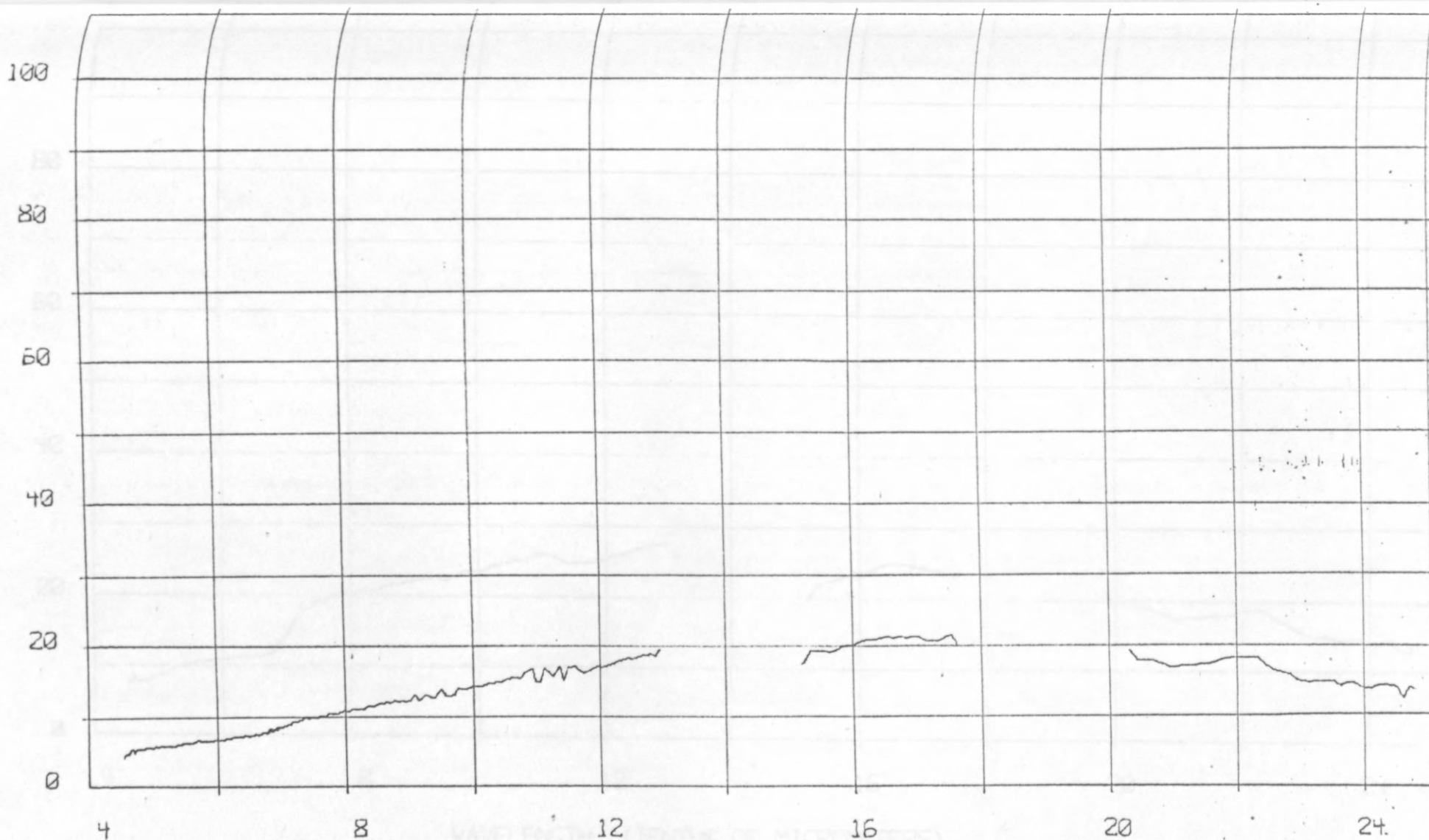
5 AUG 77

TINTIC, UTAH. TAPE (2) SITE: C-19/BIG SAGE W/H

062/063

ABSOLUTE REFLECTANCE

Fig. 12 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

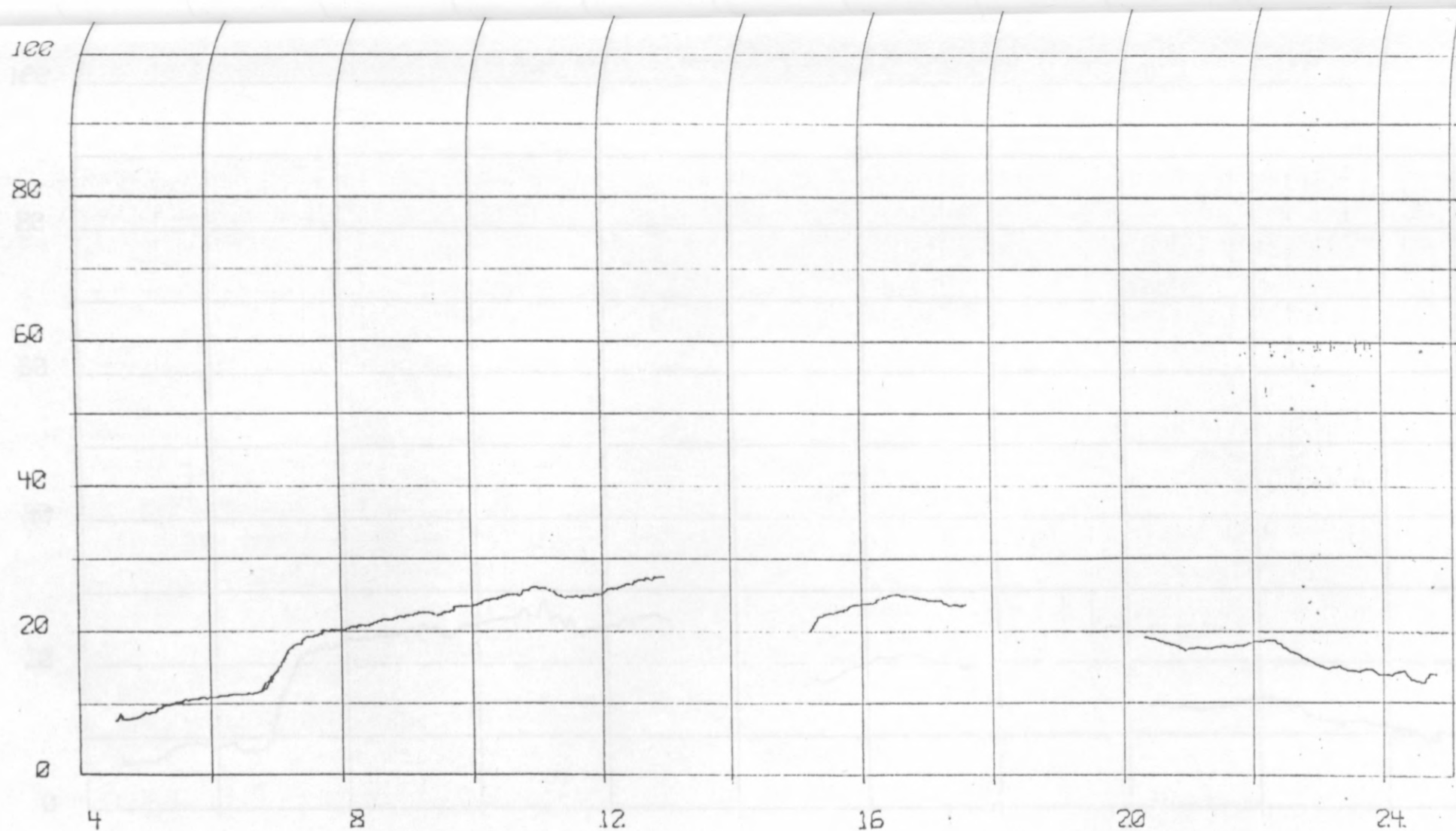
5 AUG 77

TINTIC, UTAH, TAPE (2) SITE: C-19/BIG SAGE W/O-H

054/053

ABSOLUTE REFLECTANCE

Fig. 13 *Artemisia tridentata*



WAVELENGTH (TENTHS OF MICROMETERS)

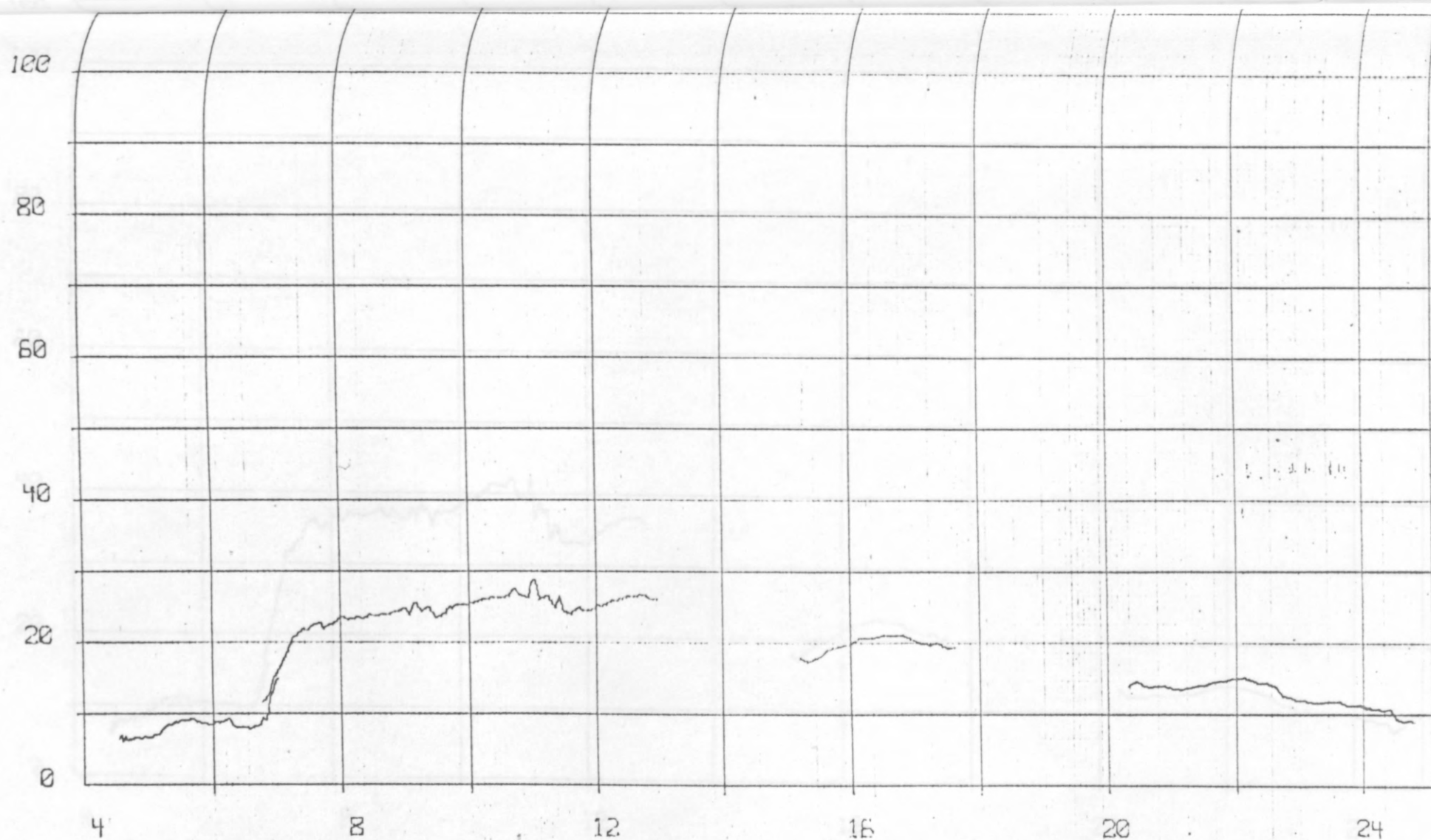
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: E-76/BIG SAGE(WOODY

335/337

ABSOLUTE REFLECTANCE

Fig. 14 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

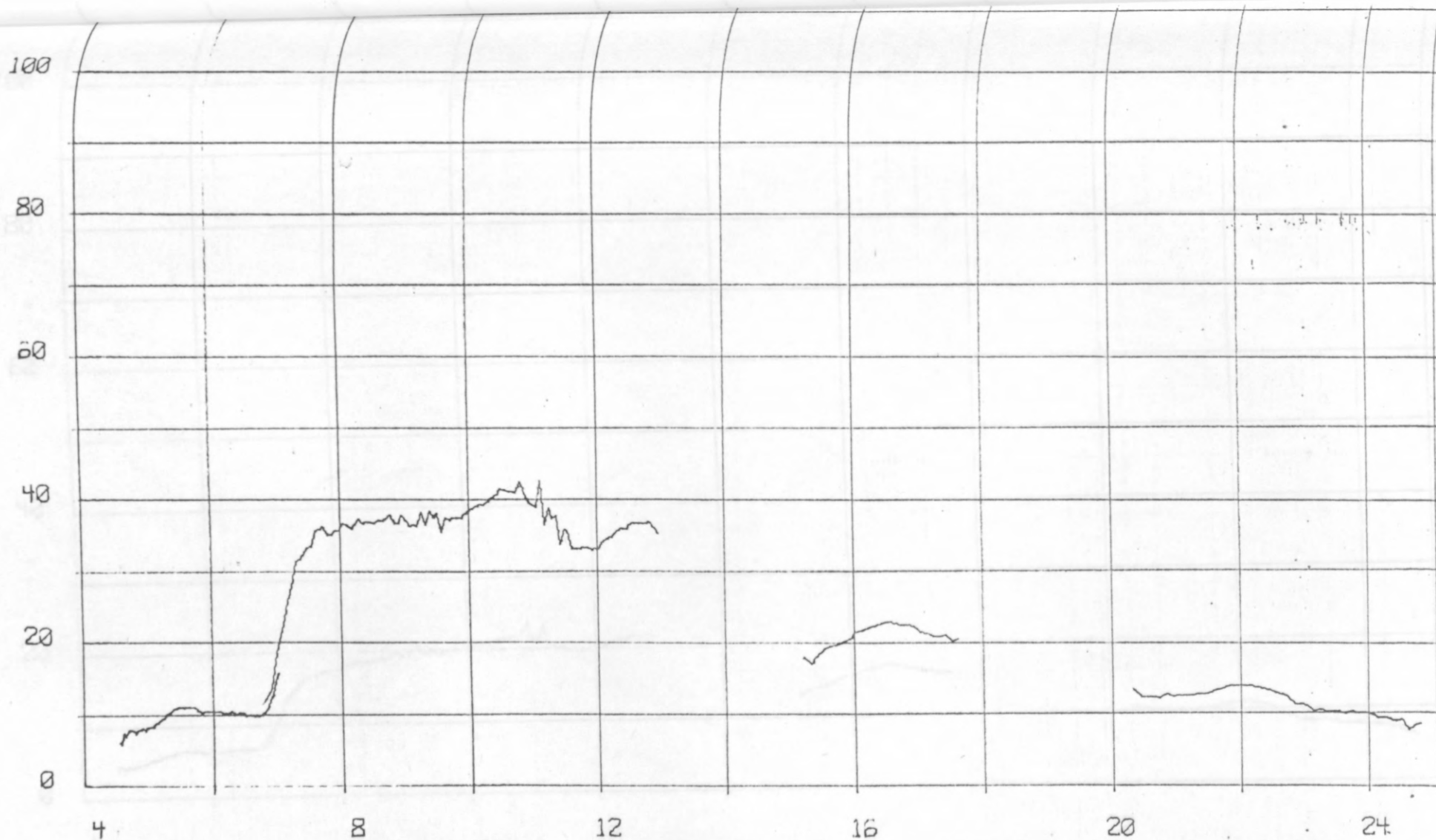
8 AUG 77

TINTIC, UTAH, TAPE (7) SITE: E-95/BIG SAGE

115/117

ABSOLUTE REFLECTANCE

Fig. 15 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

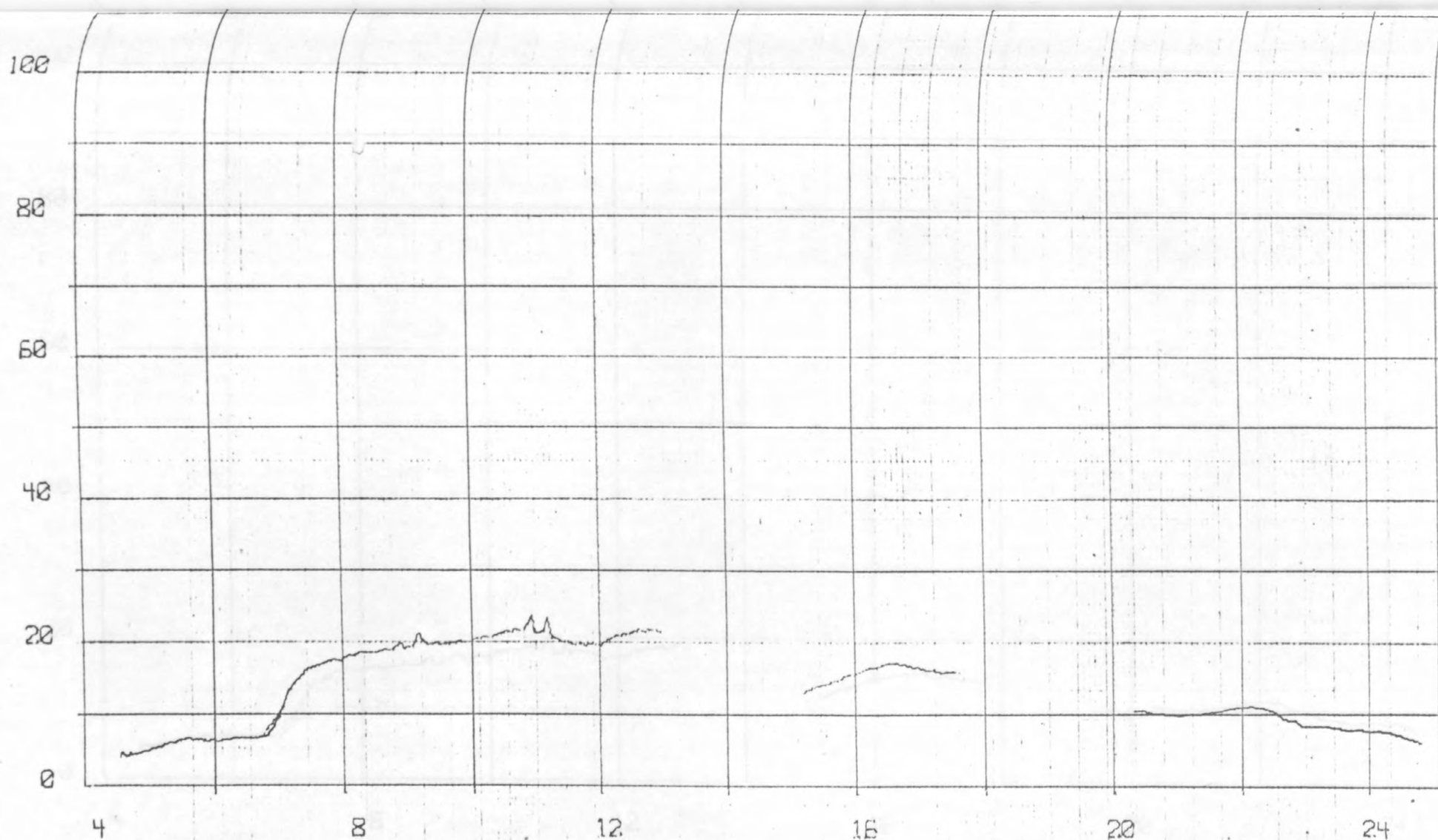
8 AUG 77

TINTIC, UTAH, TAPE (5B) SITE: A-11/BIG SAGE

031/033

ABSOLUTE REFLECTANCE

Fig. 16 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

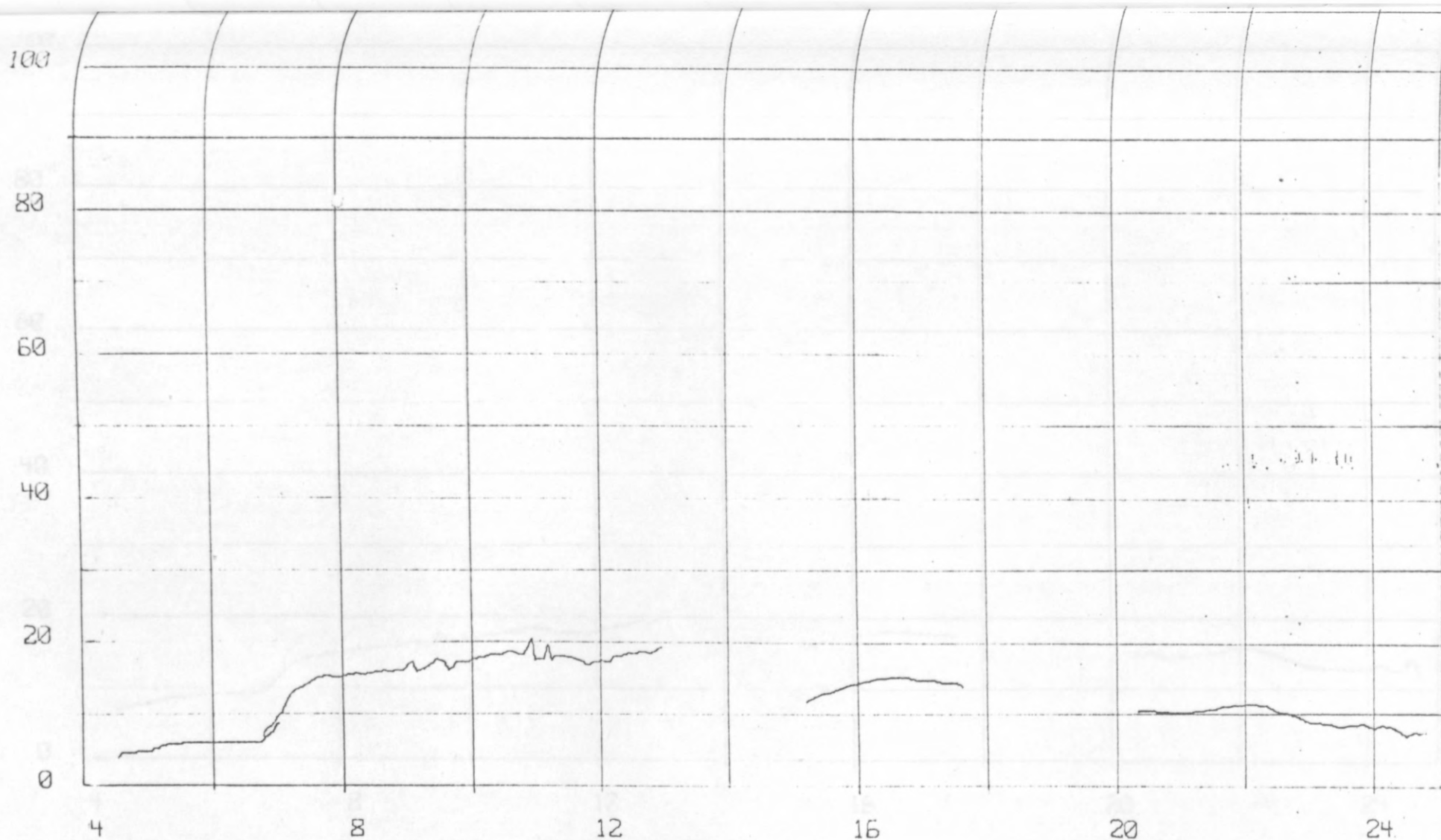
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: B-29/BIG SAGE

165/167

ABSOLUTE REFLECTANCE

Fig. 17 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

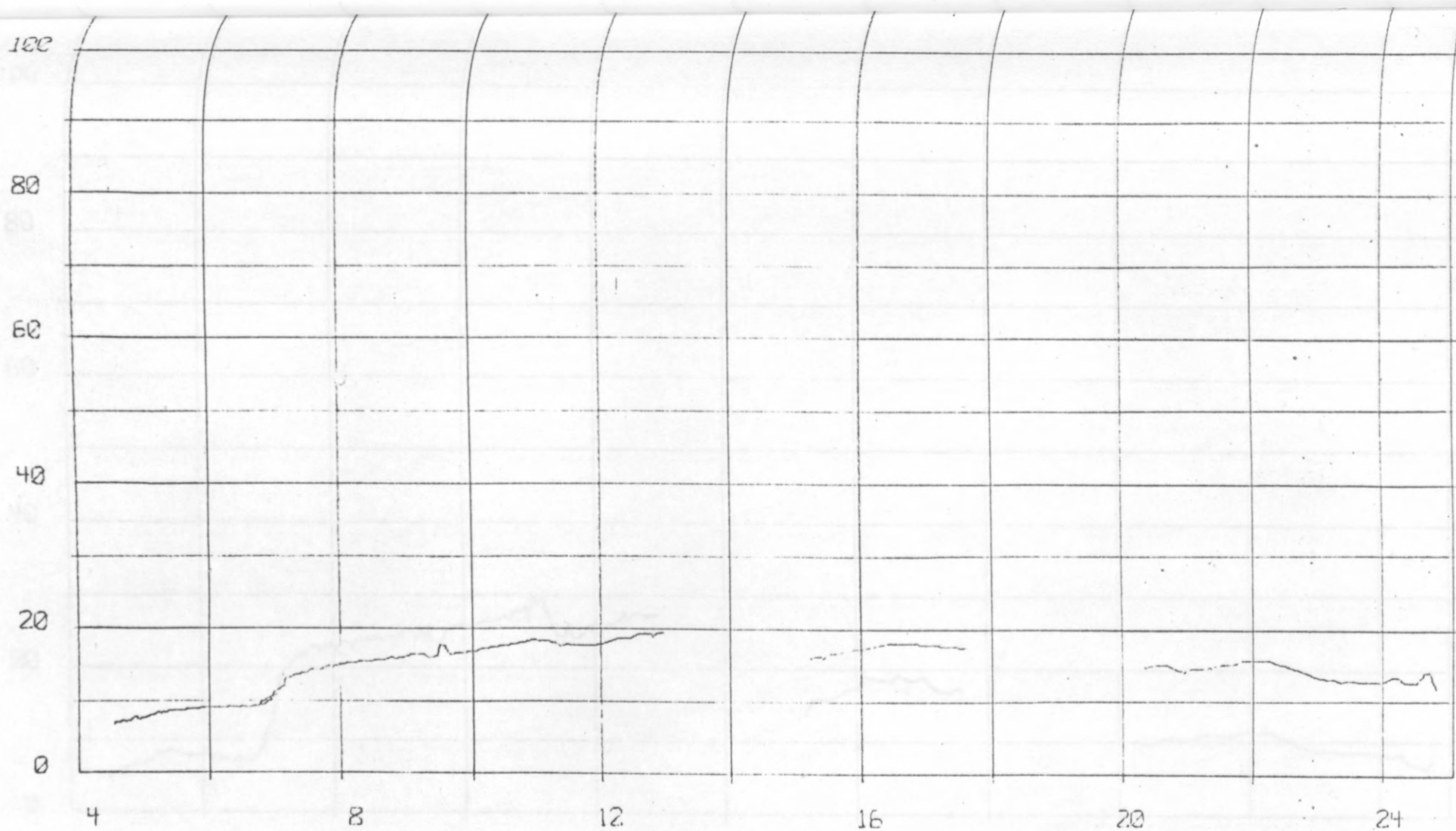
3 AUG 77

TINTIC, UTAH, TAPE (1) SITE: D-45/A. TRIDENTATA

146/147

ABSOLUTE REFLECTANCE

Fig. 18 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

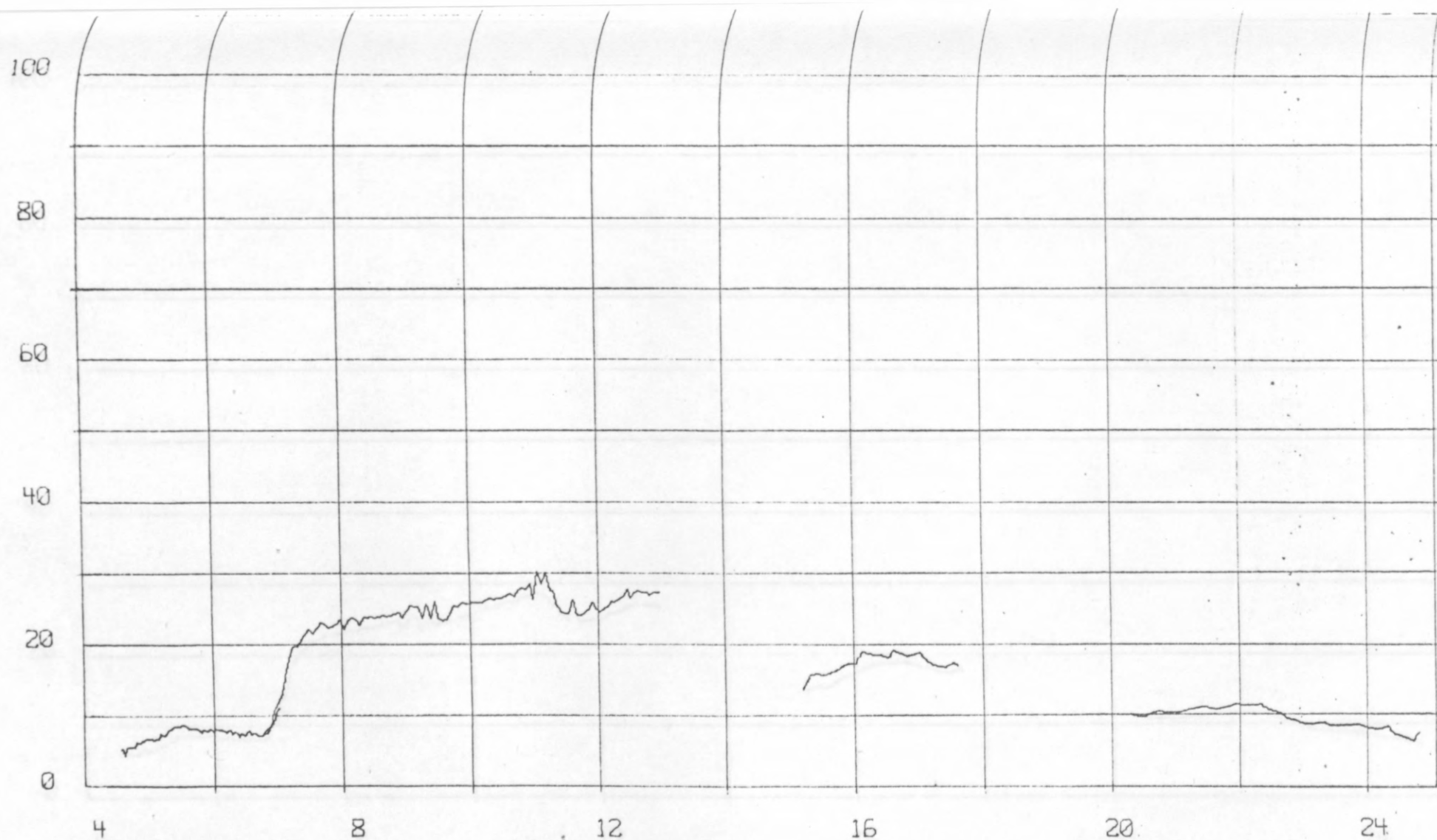
3 AUG 77

TINTIC, UTAH. TAPE (1) SITE: D-33/A. TRIDENTATA

114/115

ABSOLUTE REFLECTANCE

Fig. 19 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

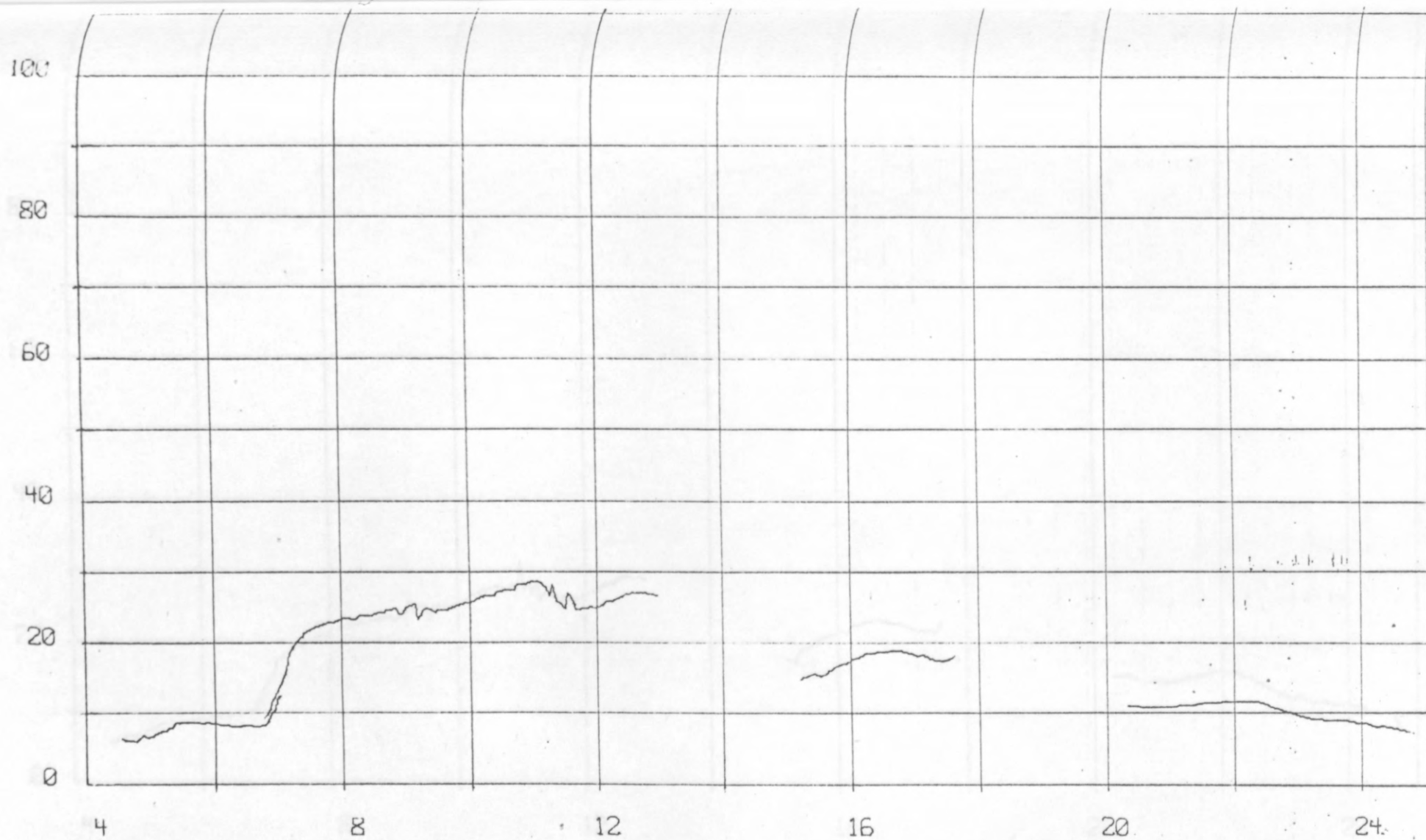
7 AUG 77

TINTIC, UTAH, TAPE (3B) SITE: A-15/BIG SAGE

122/123

ABSOLUTE REFLECTANCE

Fig. 20 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

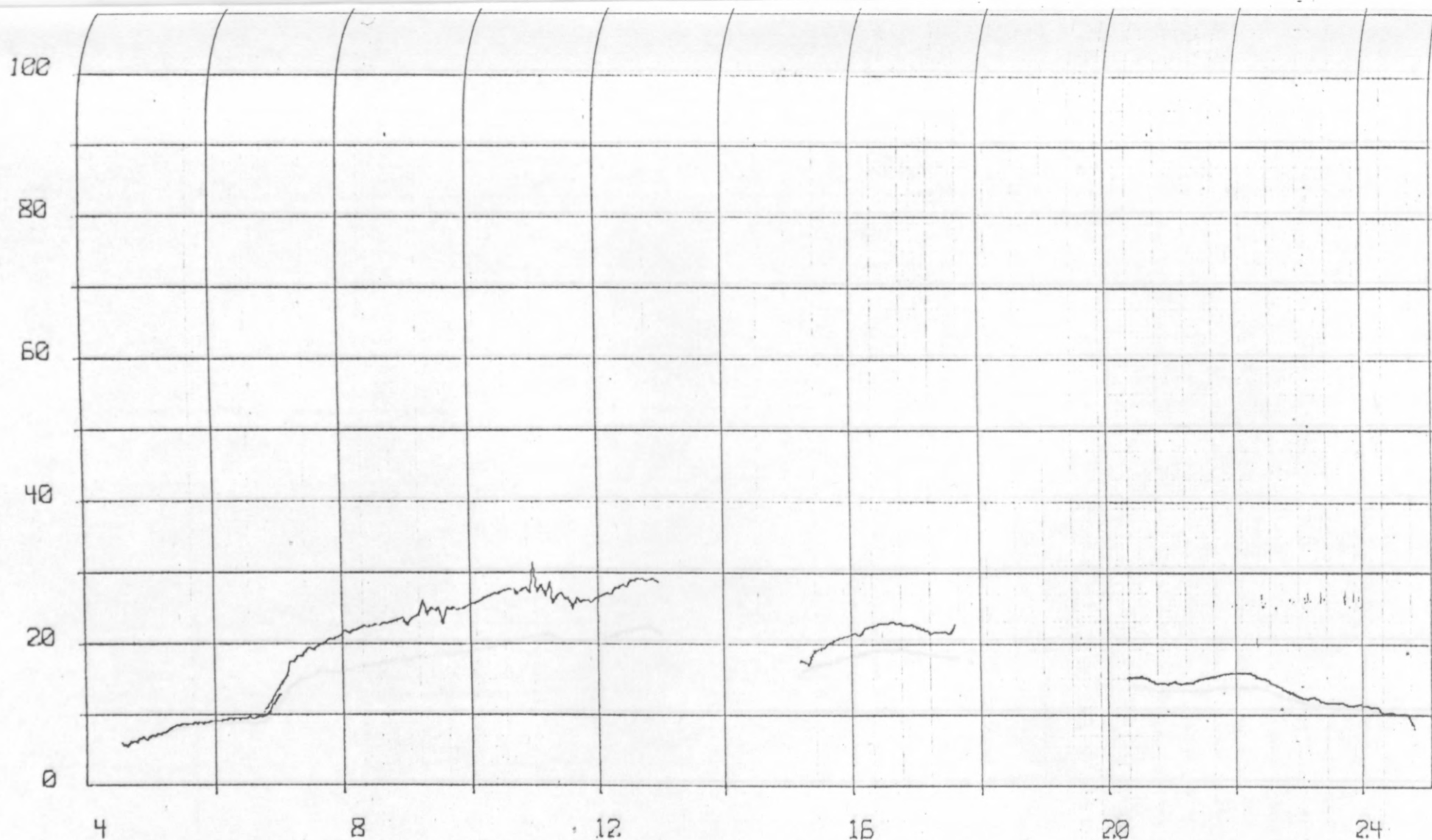
7 AUG 77

TINTIC, UTAH, TAPE (3B) SITE: A-20/BIG SAGE

134/135

ABSOLUTE REFLECTANCE

Fig. 21 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

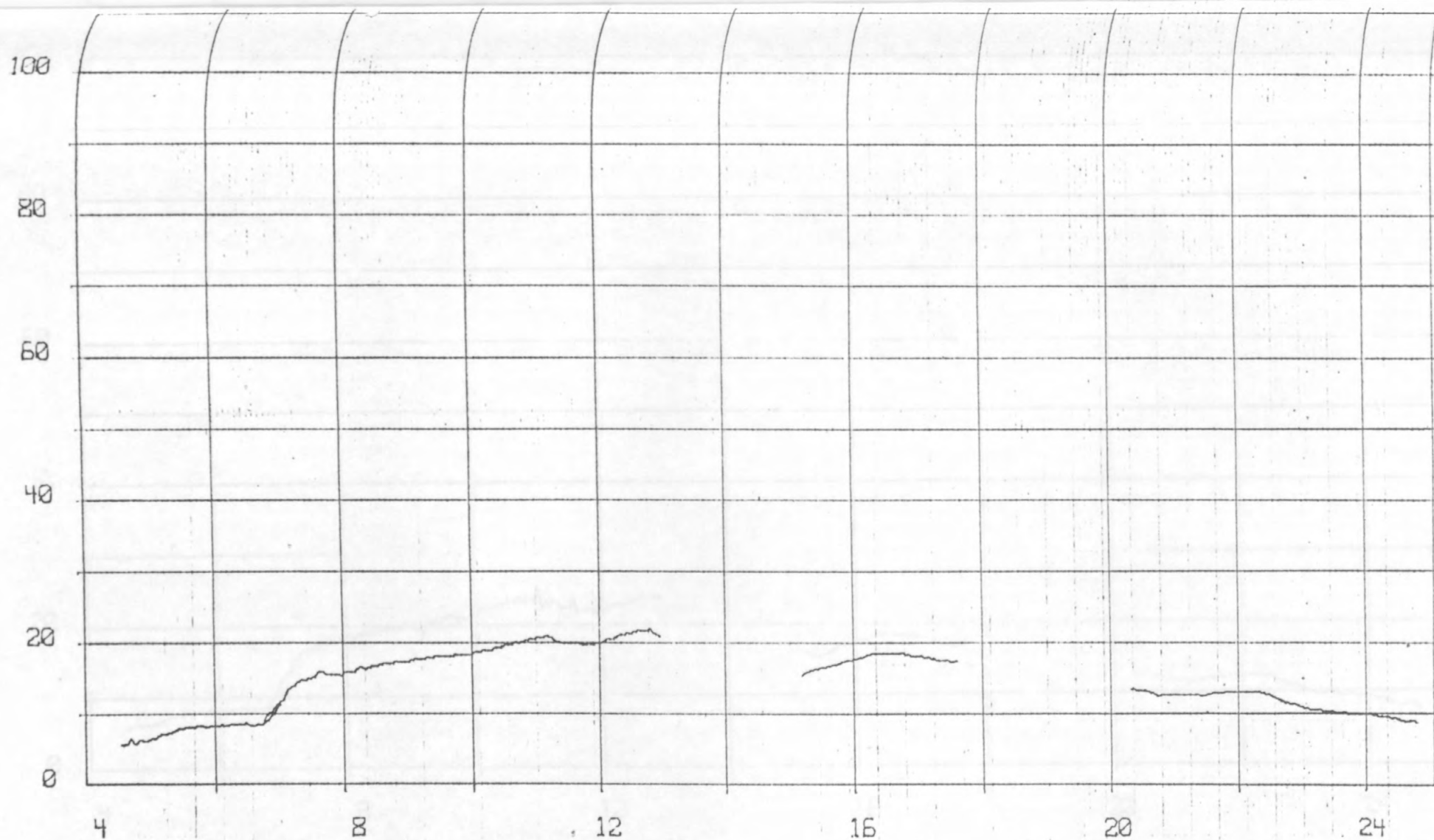
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: A-12/BIG SAGE

053/055

ABSOLUTE REFLECTANCE

Fig. 22 *Artemisia tridentata*



WAVELENGTH (TENTHS OF MICROMETERS)

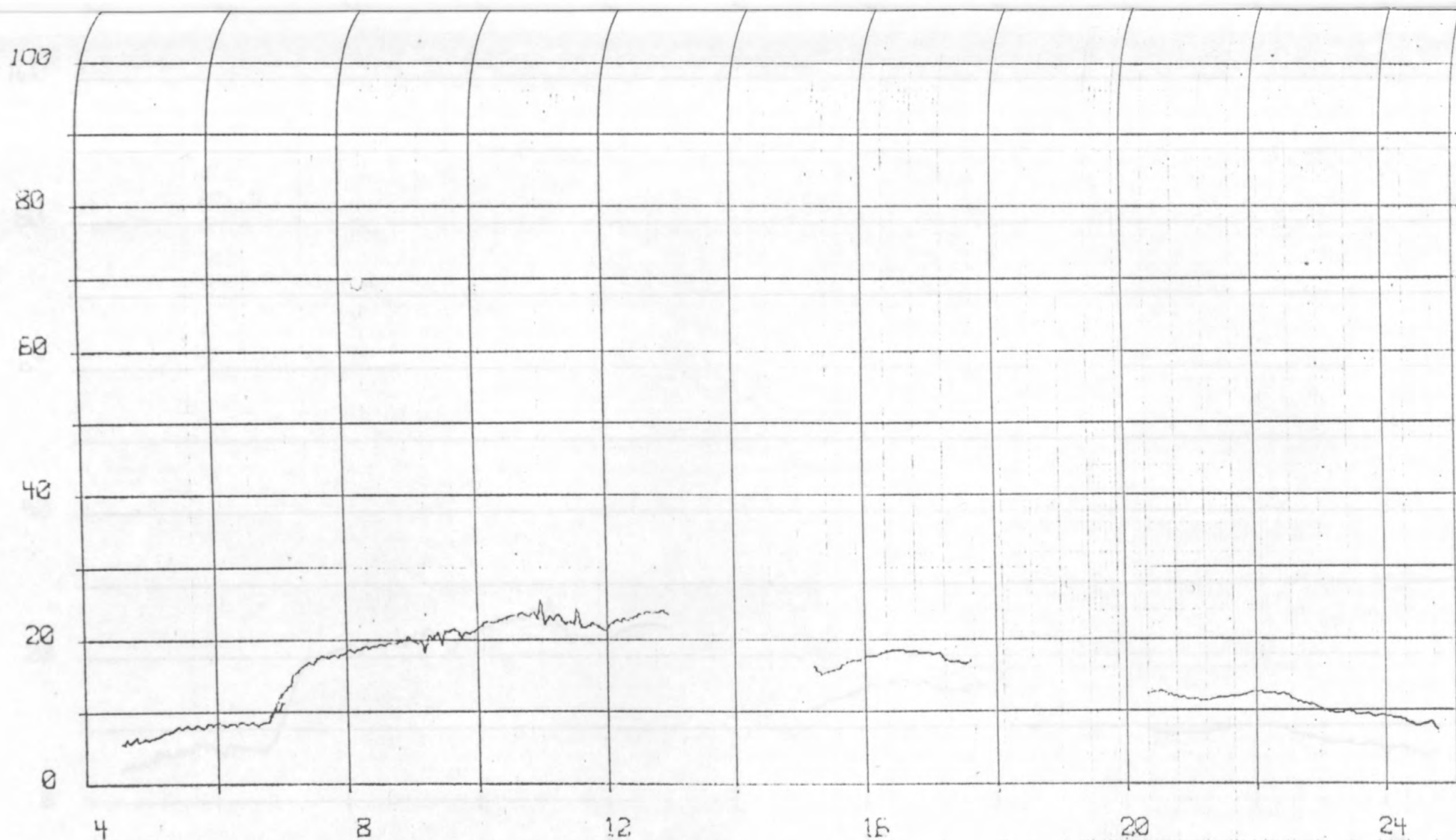
9 AUG 77

TINTIC, UTAH, TAPE ⁹(10) SITE: F-82/SAGE

161/163

ABSOLUTE REFLECTANCE

Fig. 23 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

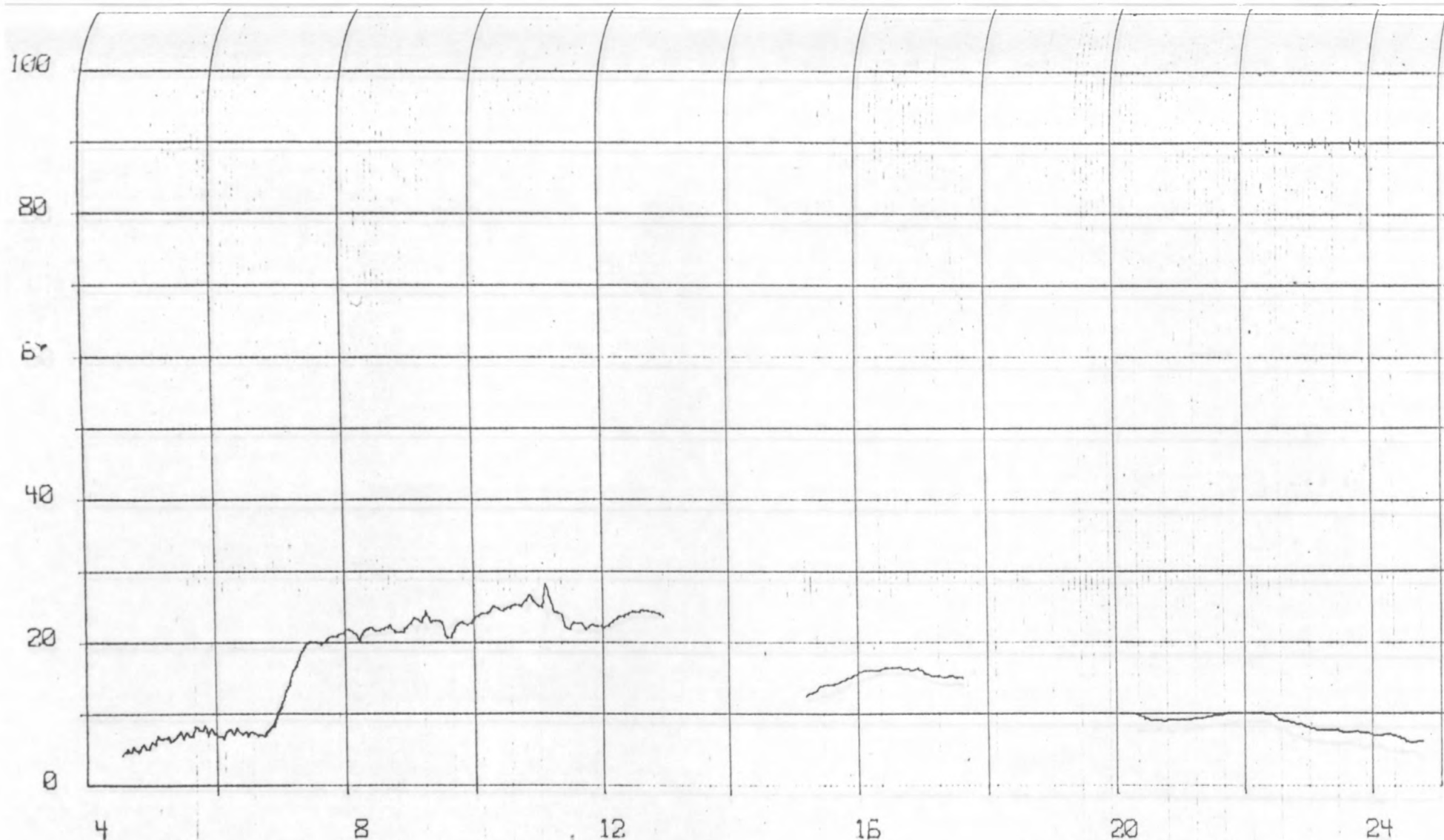
C 10 AUG 77

TINTIC, UTAH, TAPE (10) SITE: ~~X~~-35/BIG SAGE

257/261

ABSOLUTE REFLECTANCE

Fig. 24 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

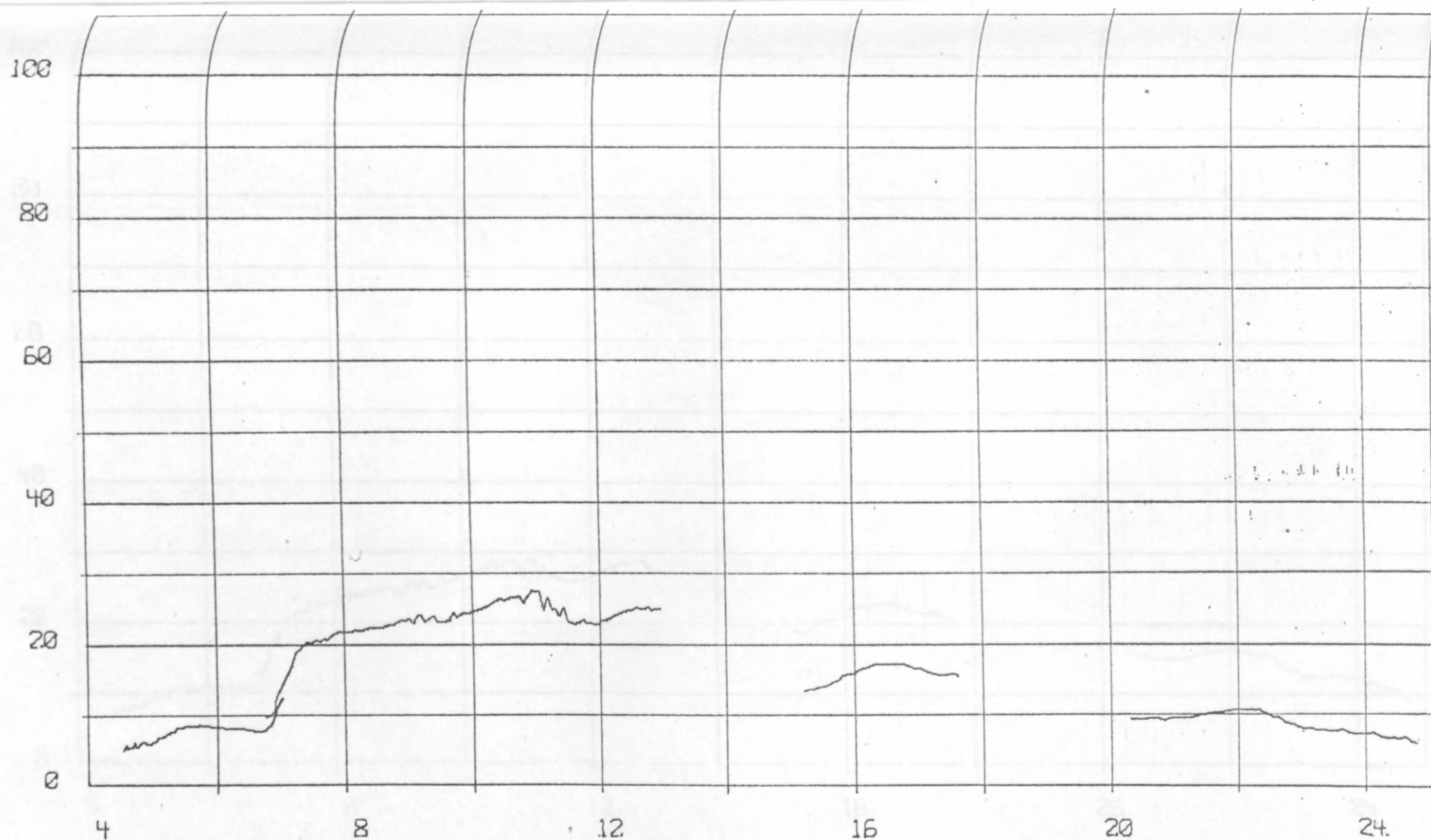
9 AUG 77

TINTIC, UTAH, TAPE ⁹(~~20~~) SITE: G-93/BIG SAGE.

235/237

ABSOLUTE REFLECTANCE

Fig. 25 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

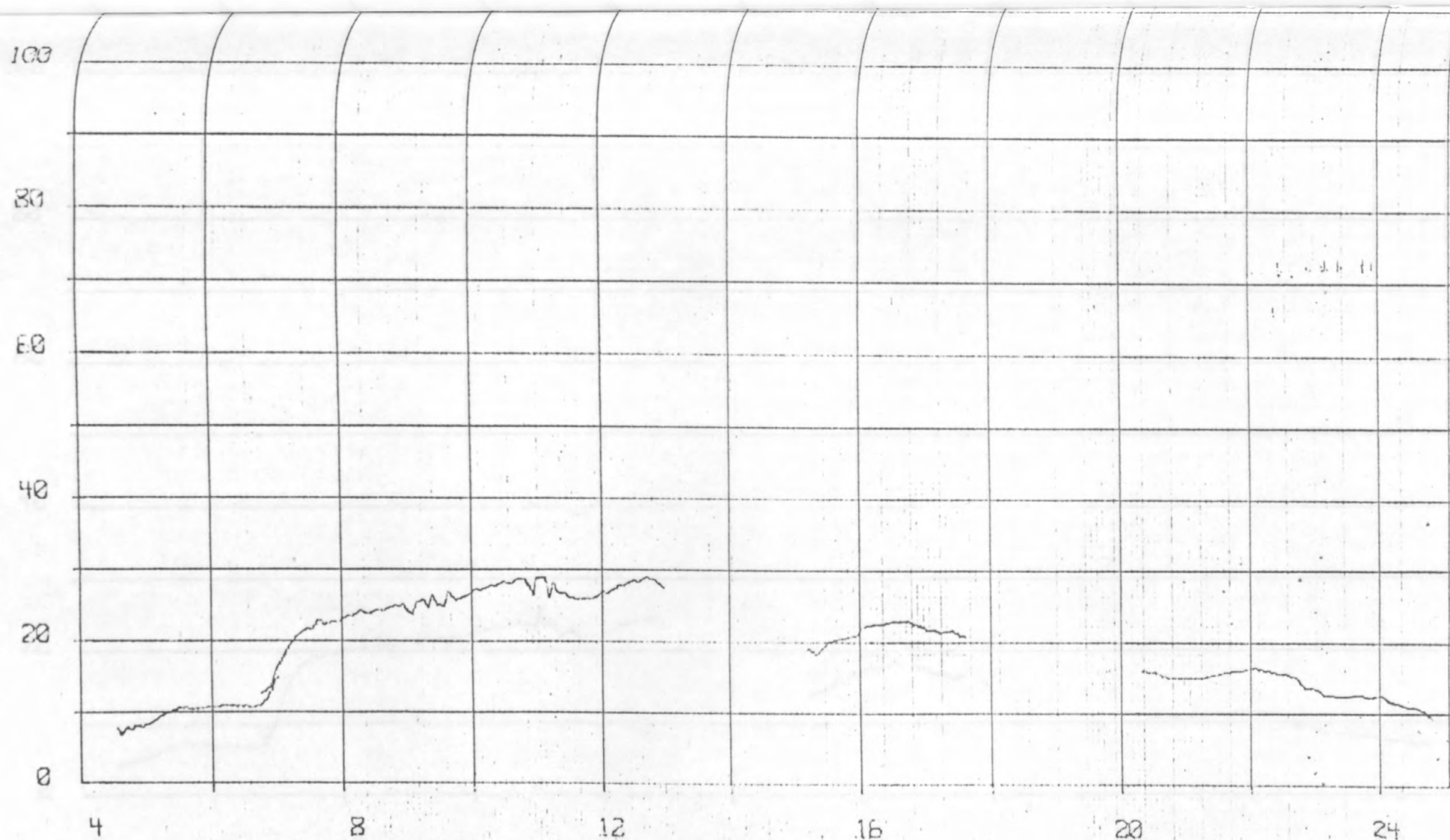
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: C-48/BIG SAGE

131/133

ABSOLUTE REFLECTANCE

Fig. 26 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

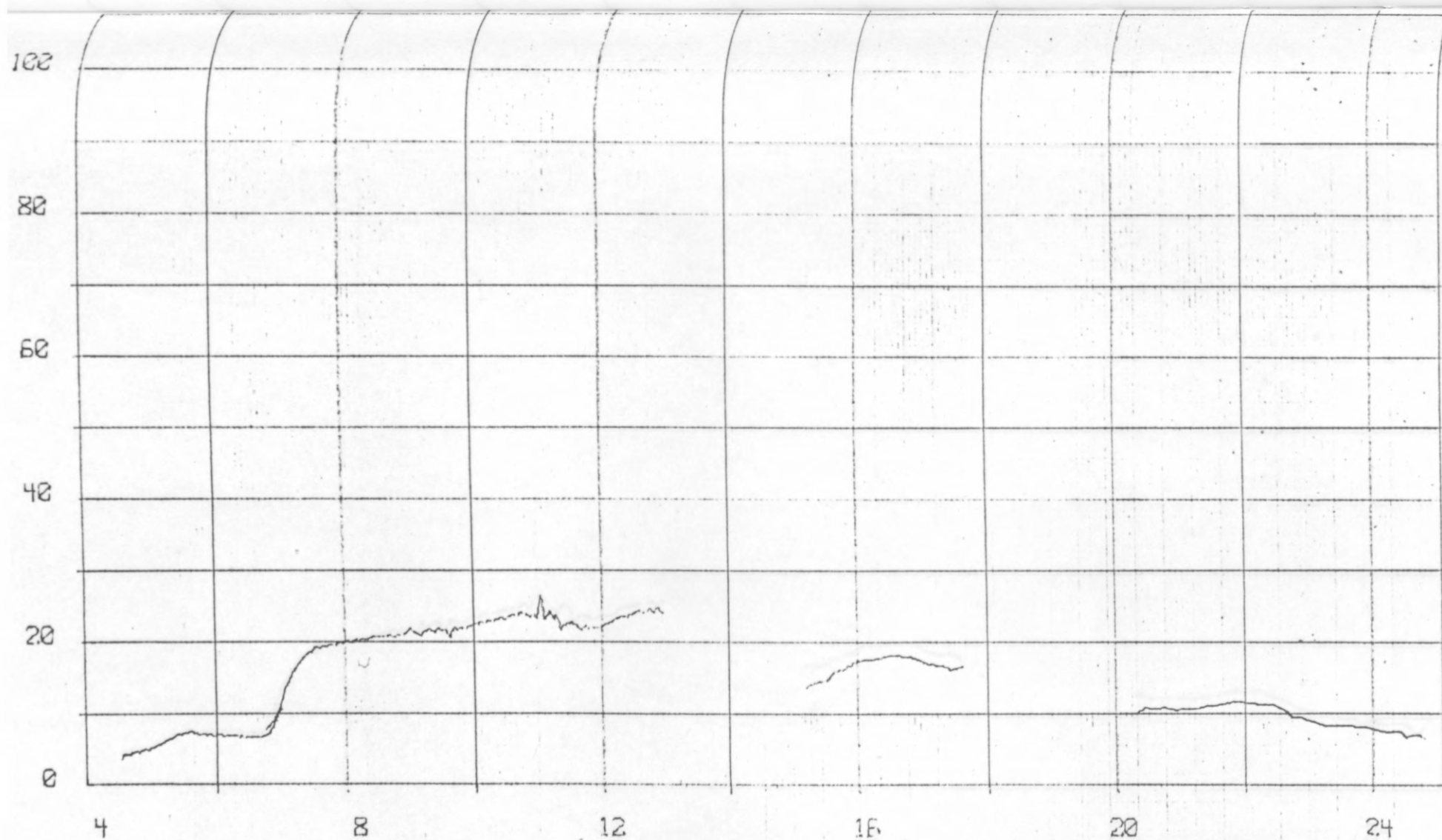
10 AUG 77

TINTIC, UTAH, TAPE (10) SITE: ^C B-32/BIG SAGE

243/245

ABSOLUTE REFLECTANCE

Fig. 27 Artemisia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

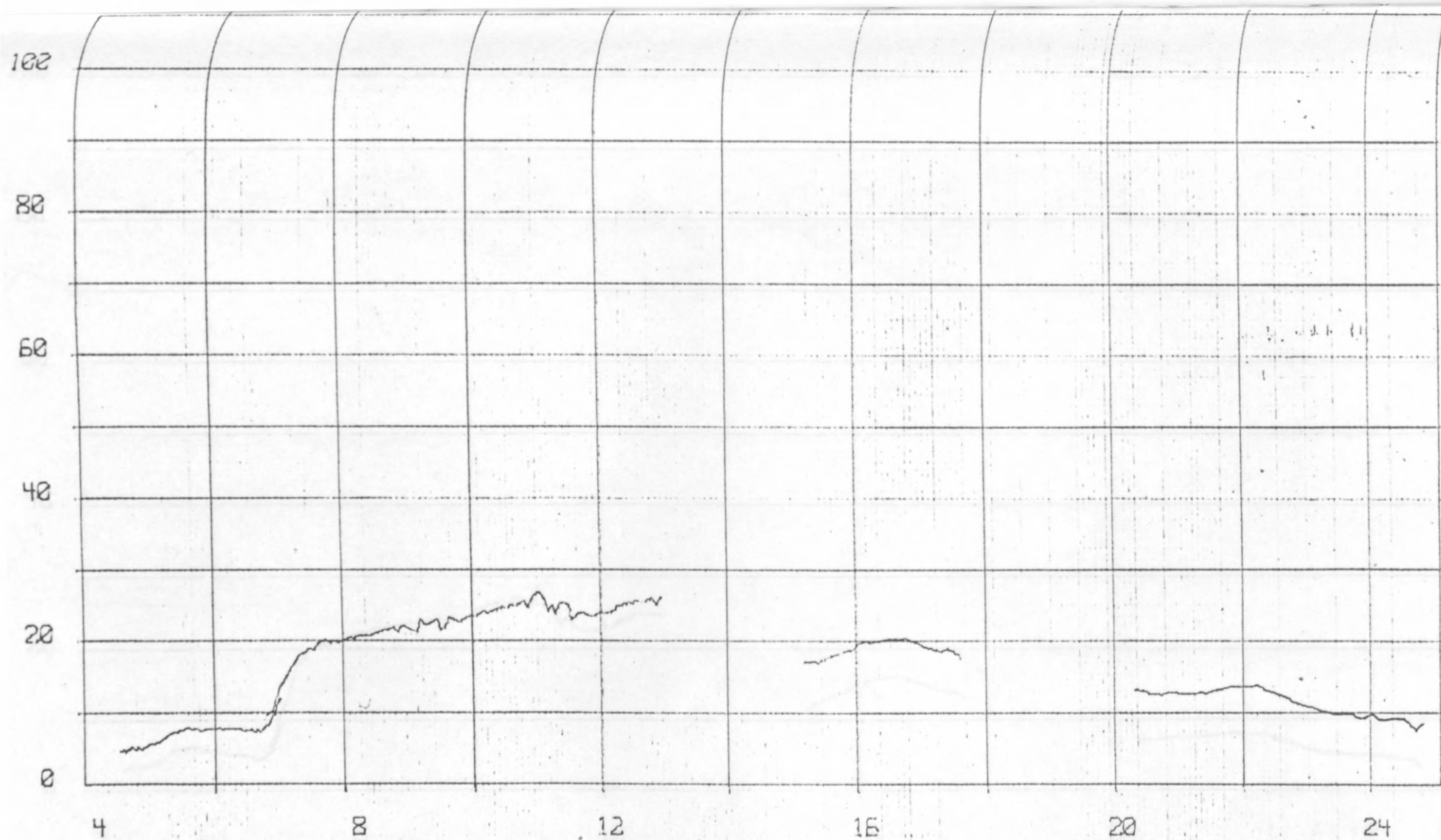
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: C-43/DWARF SAGE

261/263

ABSOLUTE REFLECTANCE

Fig. 28 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

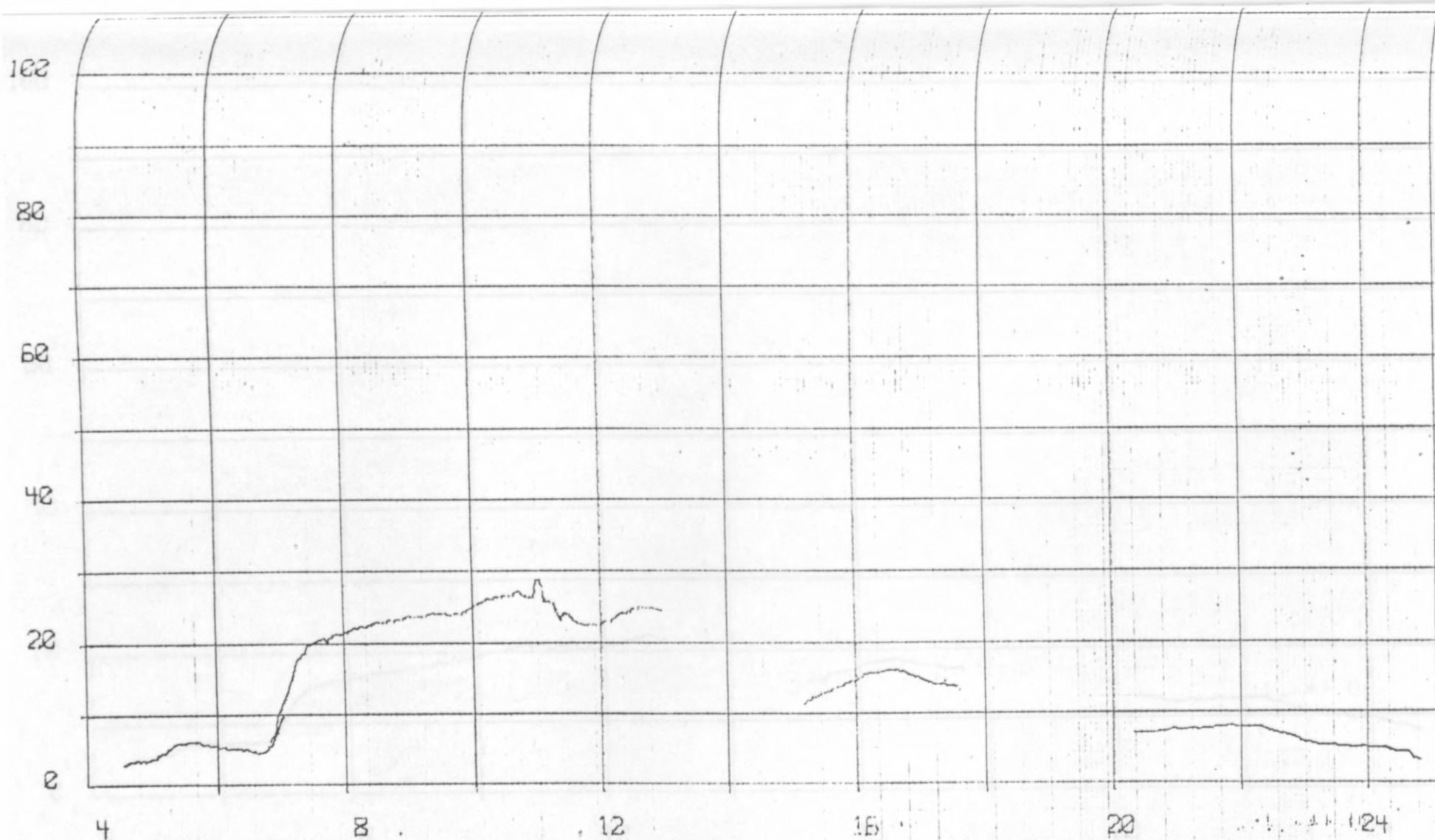
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: C-35/DWARF SAGE

215/217

ABSOLUTE REFLECTANCE

Fig. 29 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

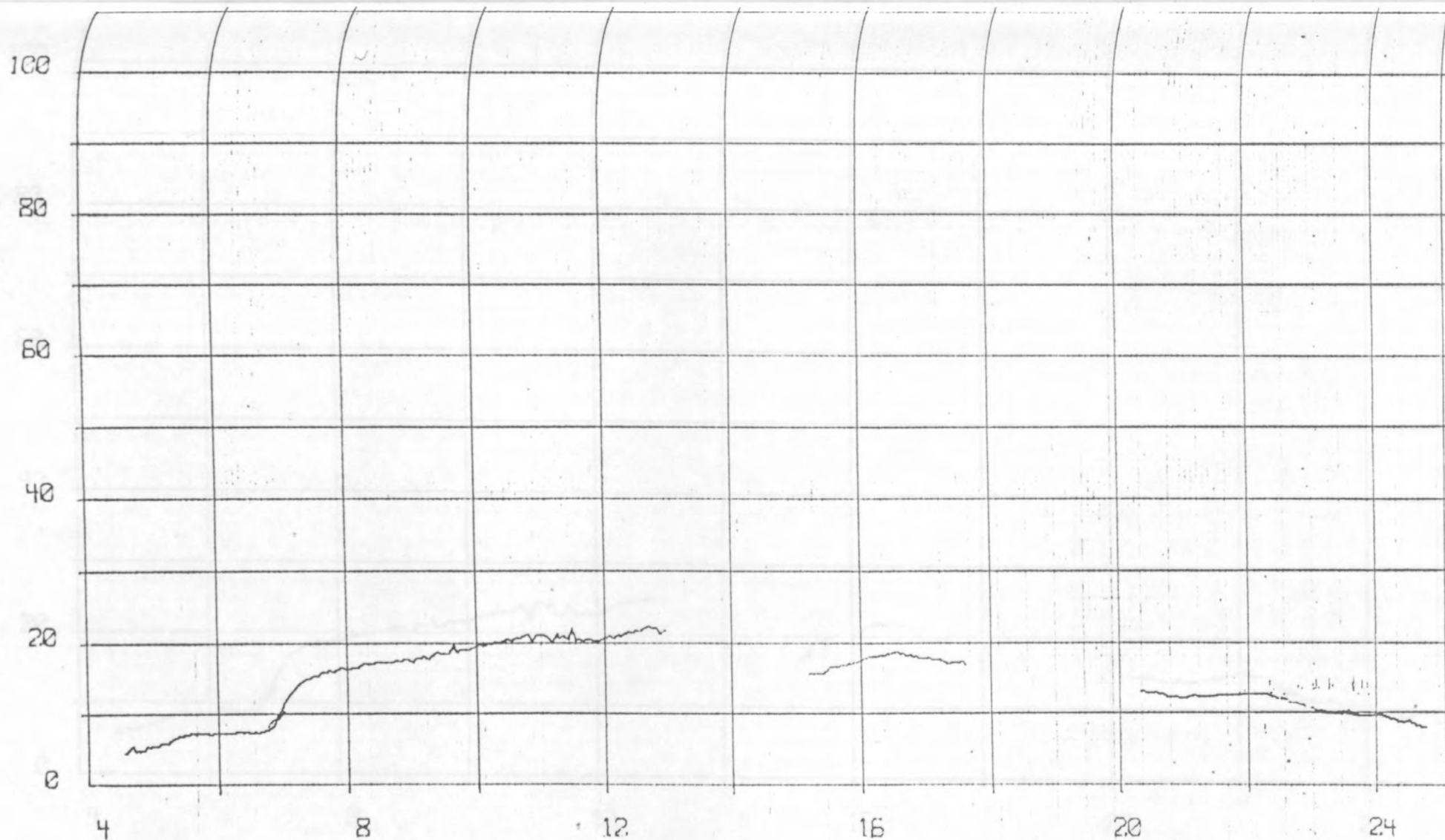
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: C-34/SAGE W/FRUIT

211/213

ABSOLUTE REFLECTANCE

Fig. 30 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

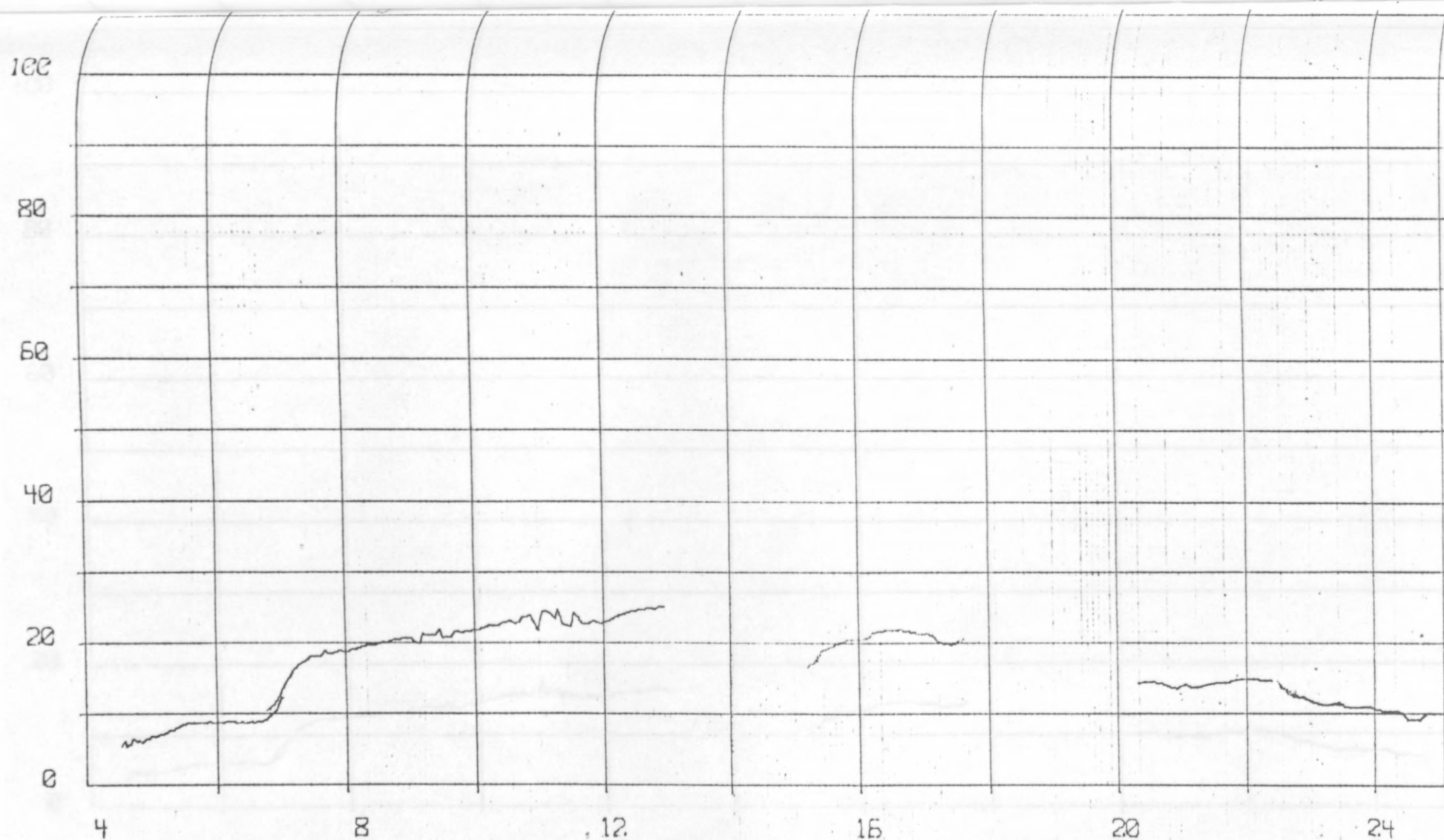
8 AUG 77

TINTIC, UTAH, TAPE (7) SITE: E-94/GRN DWARF SAGE

111/113

ABSOLUTE REFLECTANCE

Fig. 31 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

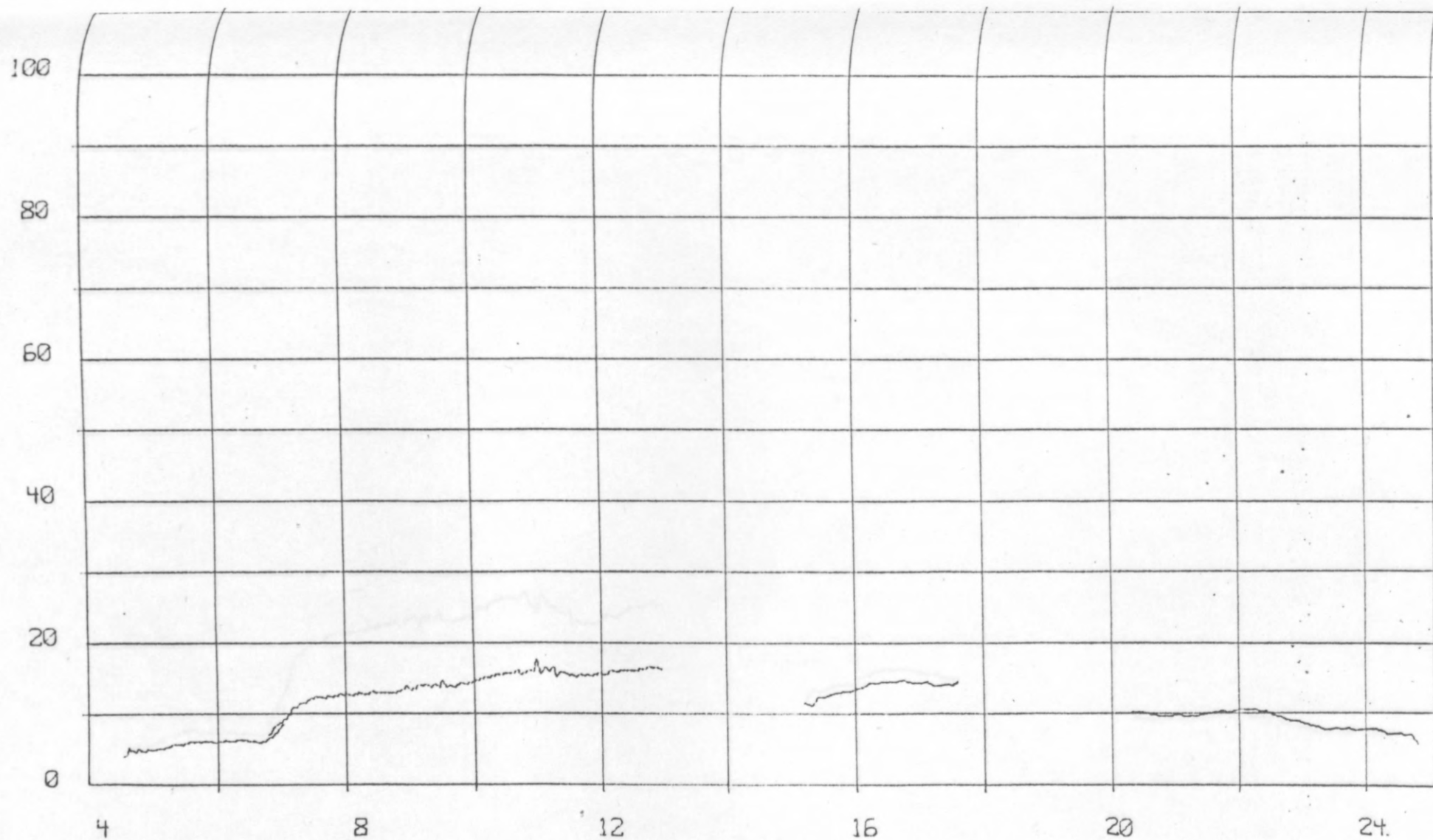
8 AUG 77

TINTIC, UTAH, TAPE (7) SITE: E-93/DWARF SAGE

103/105

ABSOLUTE REFLECTANCE

Fig. 32 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

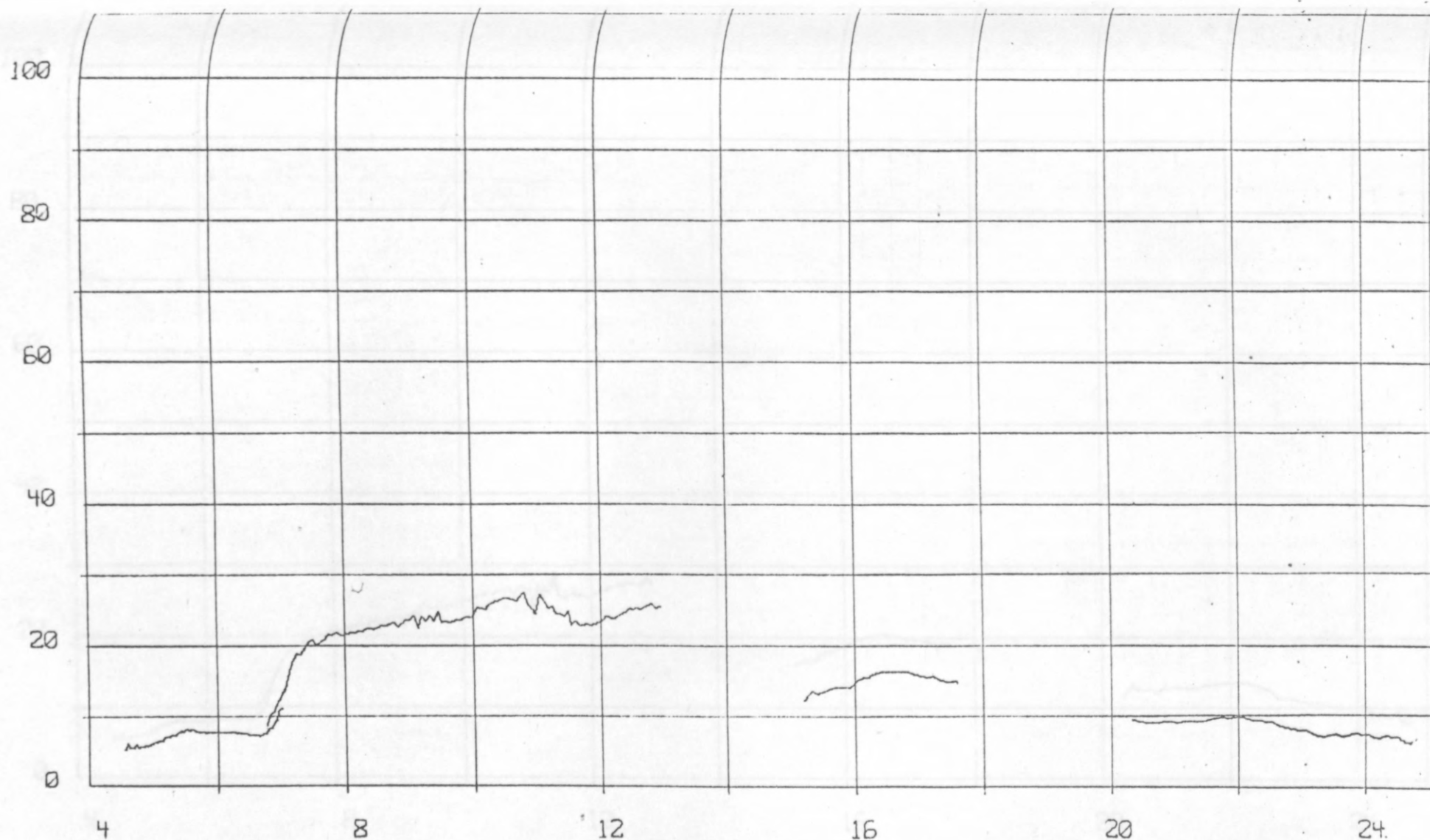
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: B-33/A. ARBUSCULA

035/037

ABSOLUTE REFLECTANCE

Fig. 33 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

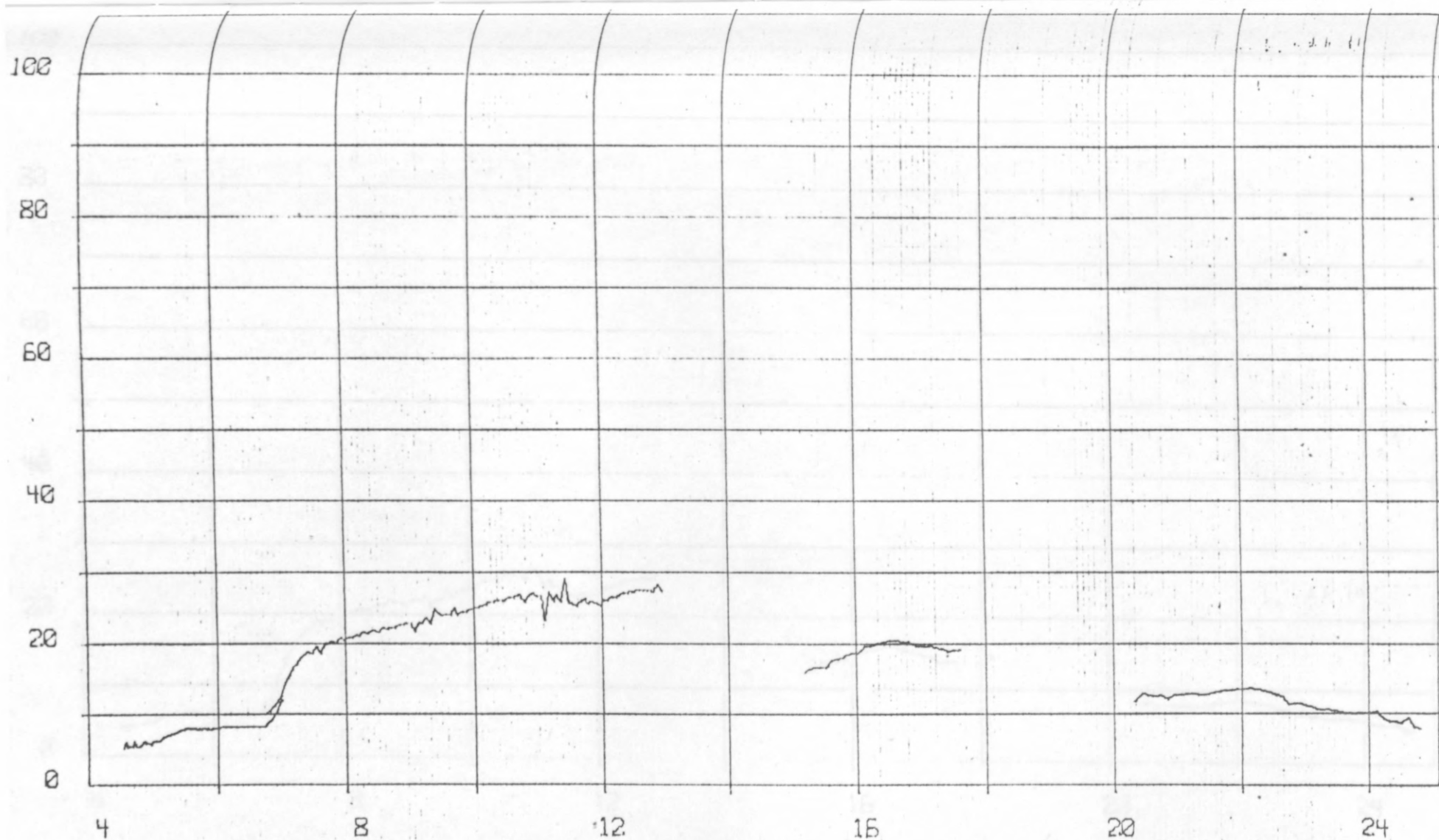
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: B-34/SOB-SEE LABOOK

041/043

ABSOLUTE REFLECTANCE

Fig. 34 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

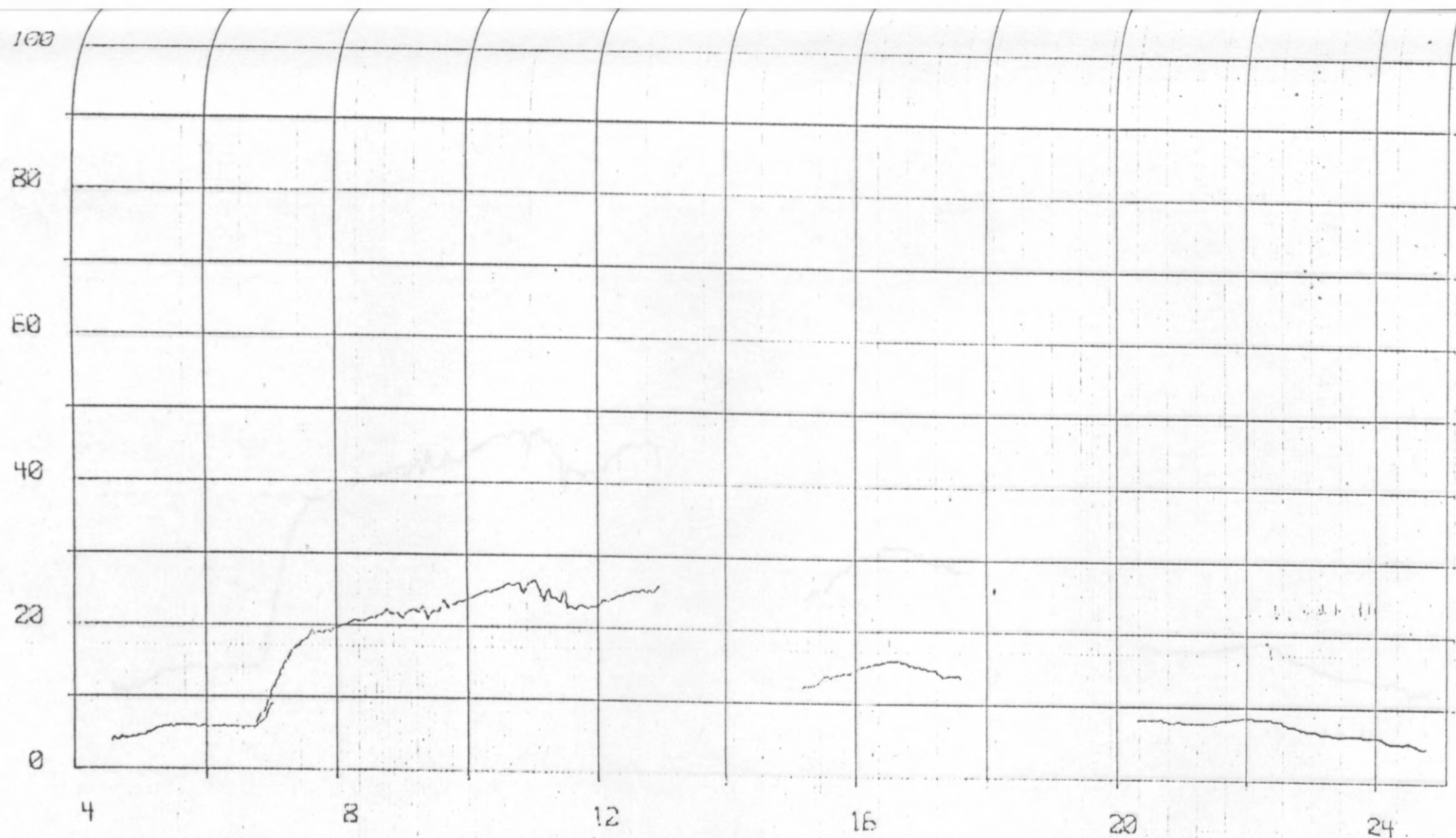
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: A-13/DWARF SAGE

057/061

ABSOLUTE REFLECTANCE

Fig. 35 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

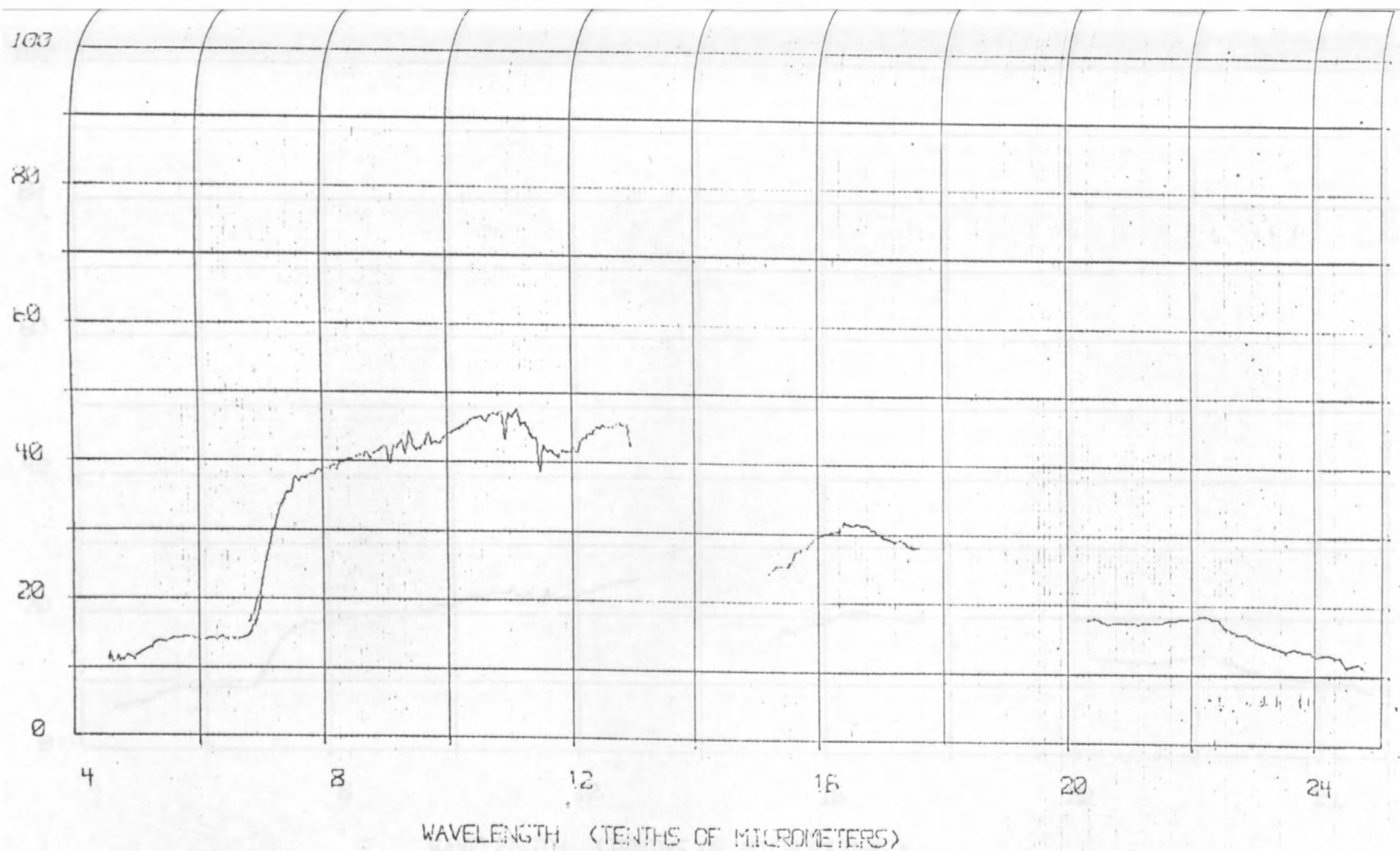
C 10 AUG 77

TINTIC, UTAH, TAPE (10) SITE: ~~X~~-37/DWARF SAGE

271/273

ABSOLUTE REFLECTANCE

Fig. 36 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

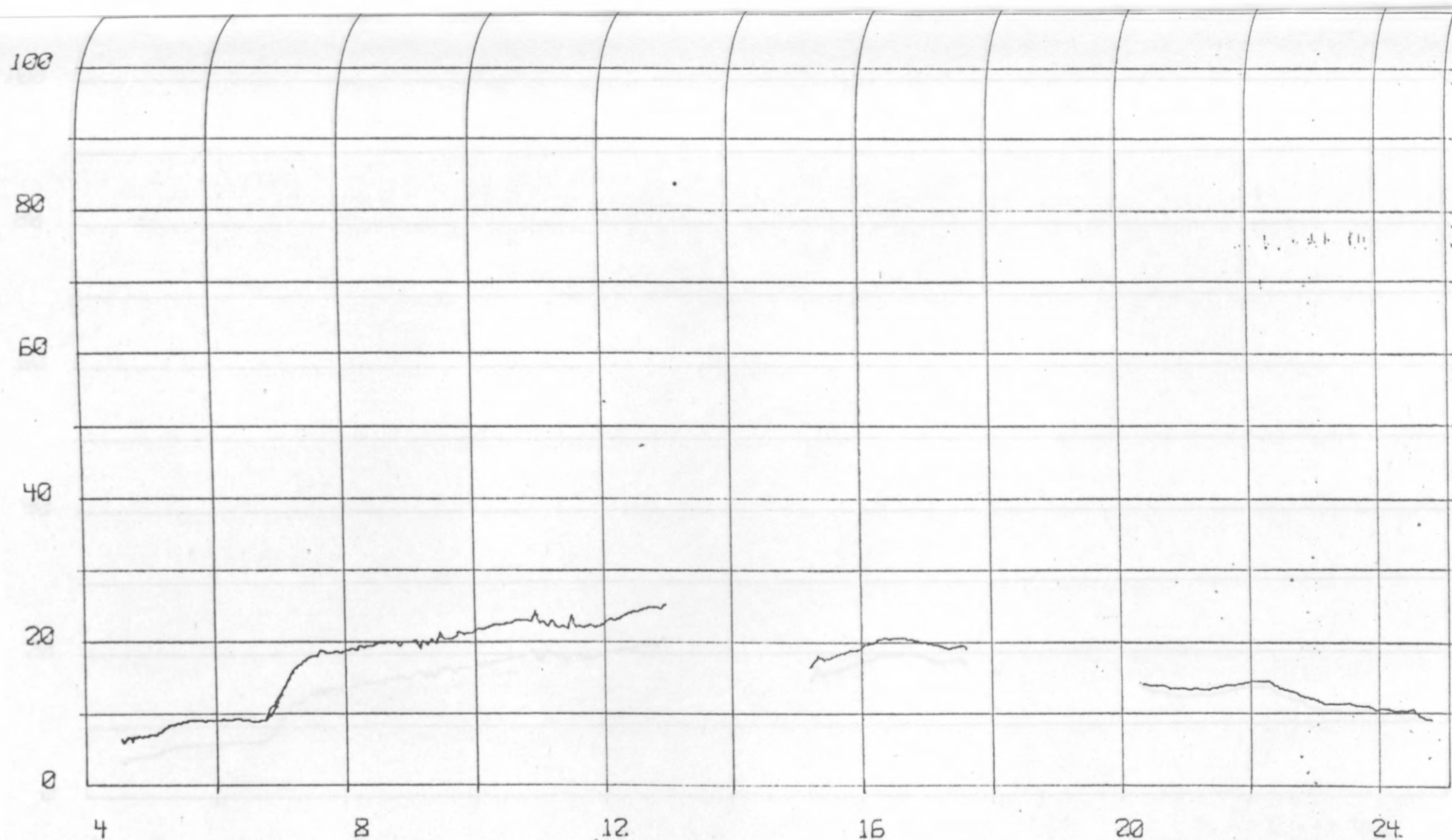
10 AUG 77

INTIC, UTAH, TAPE 010 SITE: ~~S~~-38/DWARF SAGE

275/277

ABSOLUTE REFLECTANCE

Fig. 37 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

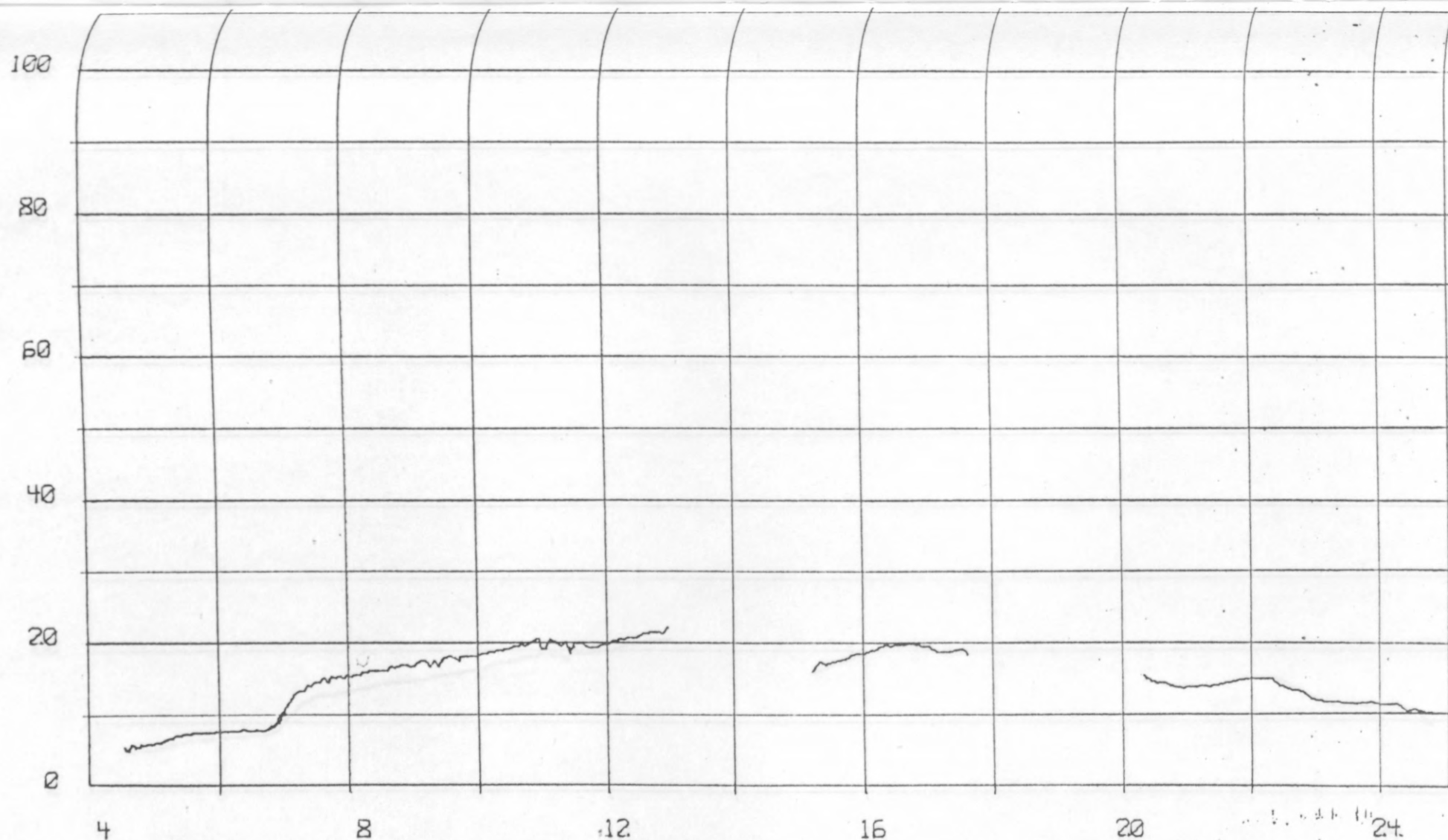
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: D-61/DWARF SAGE

233/235

ABSOLUTE REFLECTANCE

Fig. 38 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

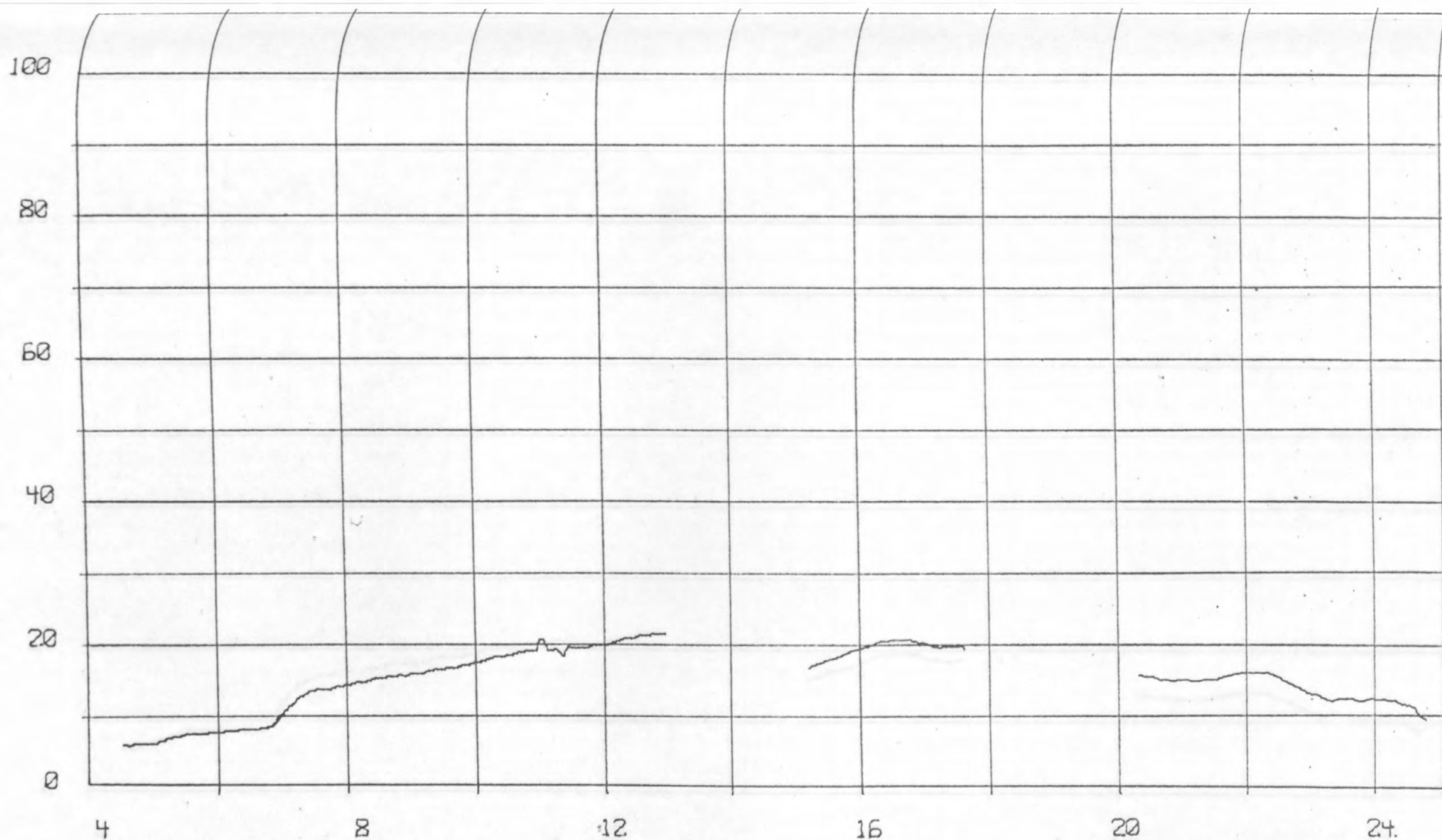
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: D-56/DWARF SAGE

207/211

ABSOLUTE REFLECTANCE

Fig. 39 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

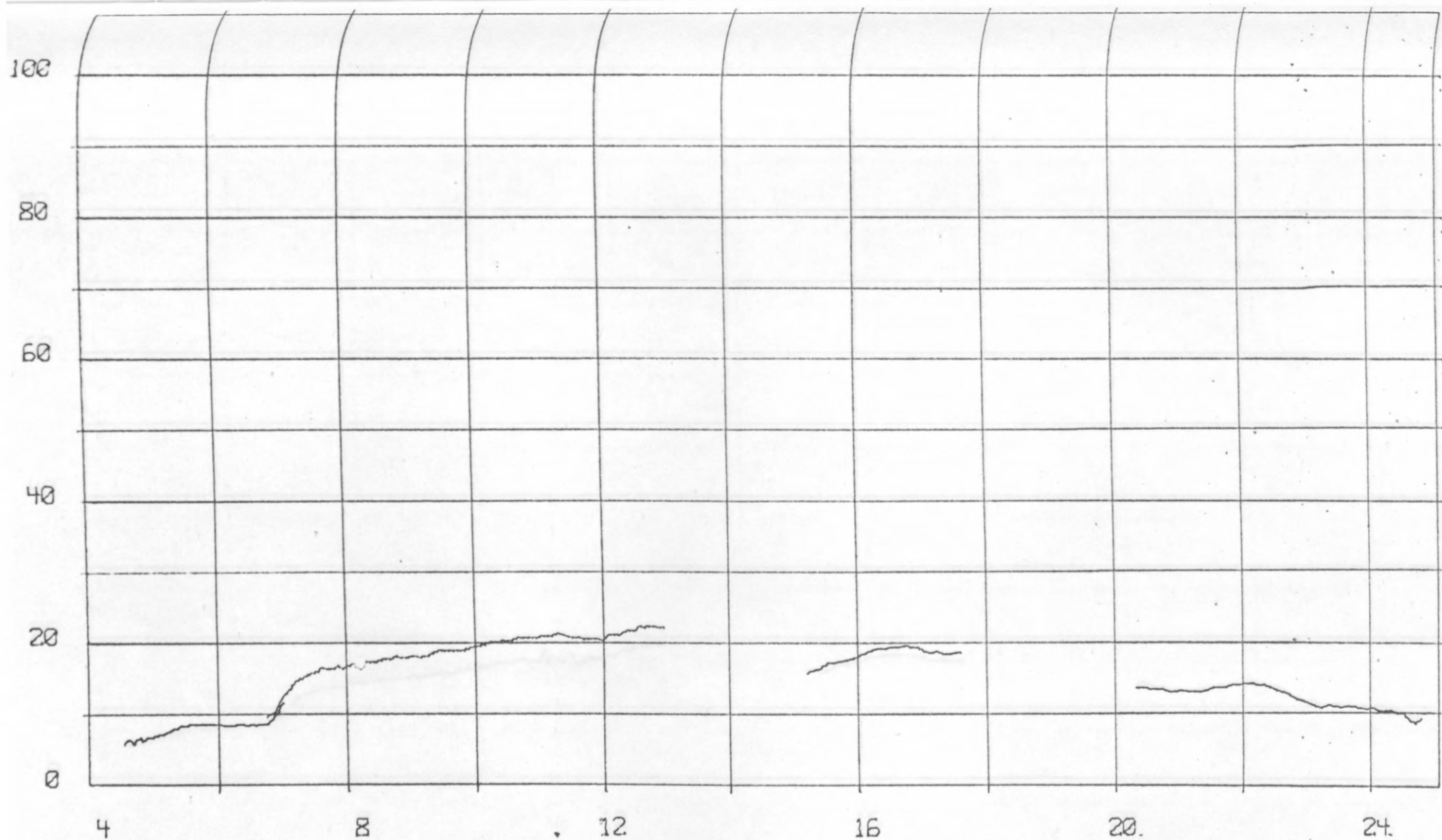
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: C-47/DWARF SAGE

125/127

ABSOLUTE REFLECTANCE

Fig. 40 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

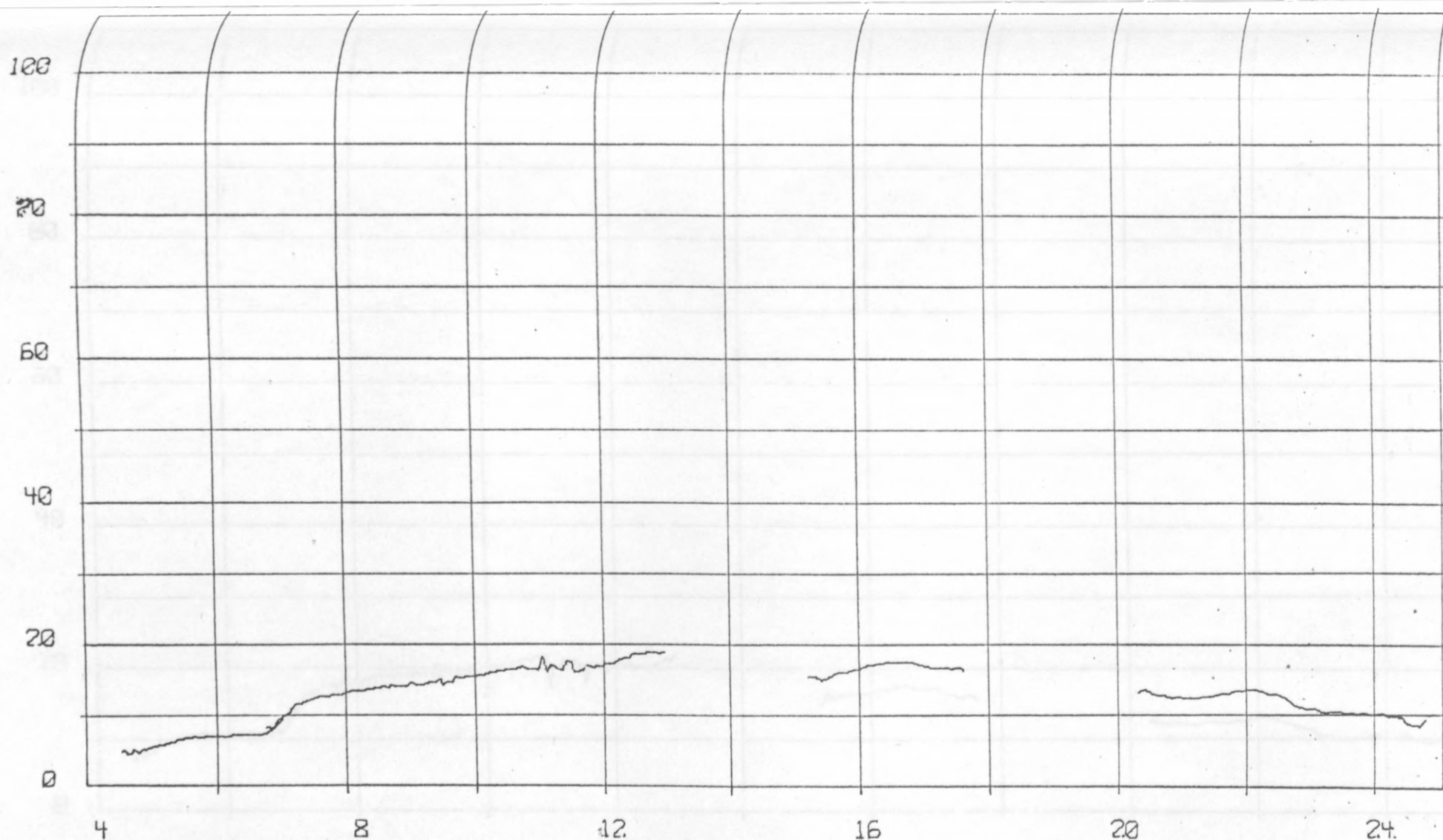
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: C-46/DWARF SAGE

121/123

ABSOLUTE REFLECTANCE

Fig. 41 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

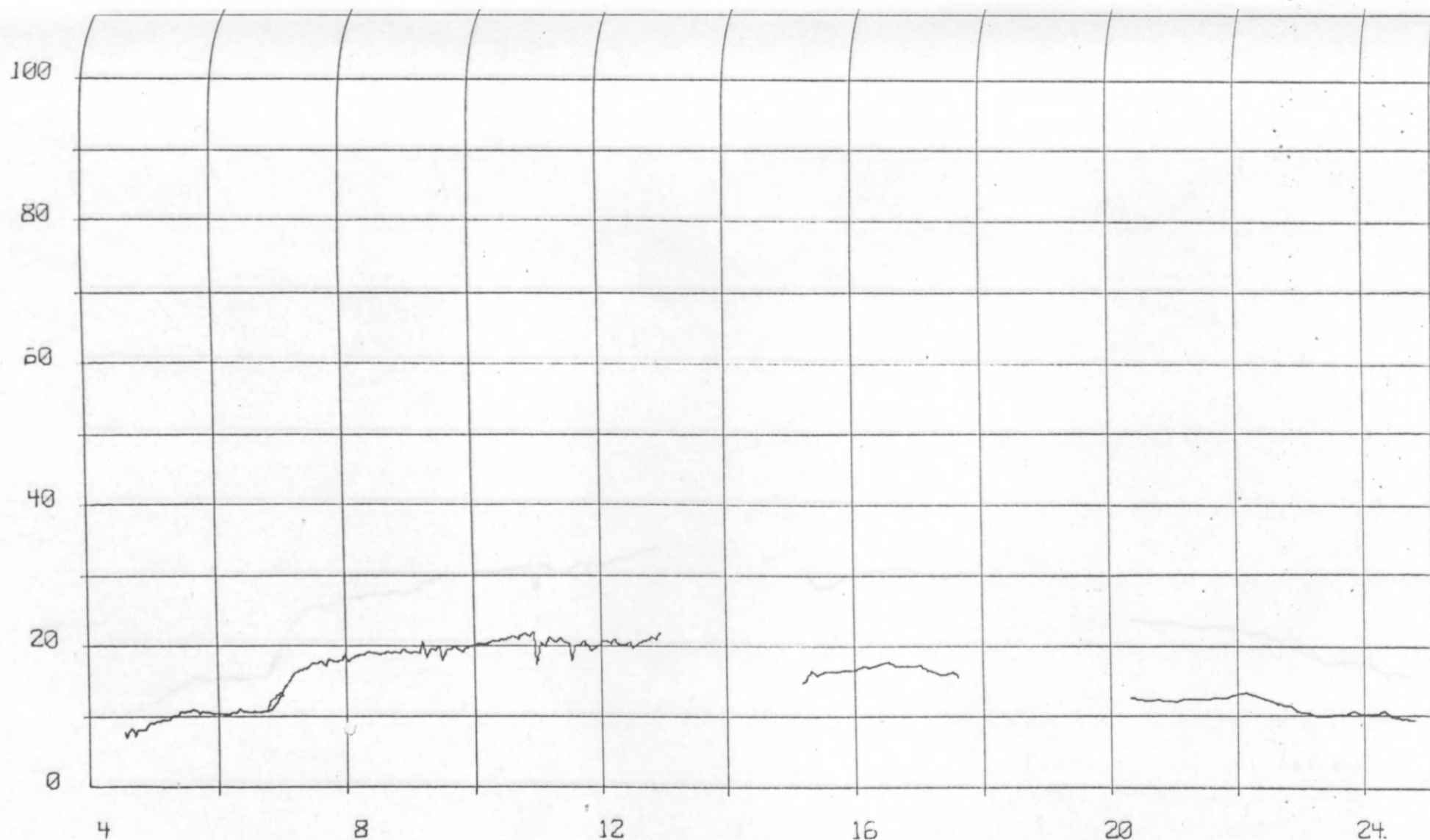
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: C-54/ODD DWARF SAGE.

177/201

ABSOLUTE REFLECTANCE.

Fig. 42 Artemisia nova



WAVELENGTH (TENTHS OF MICROMETERS)

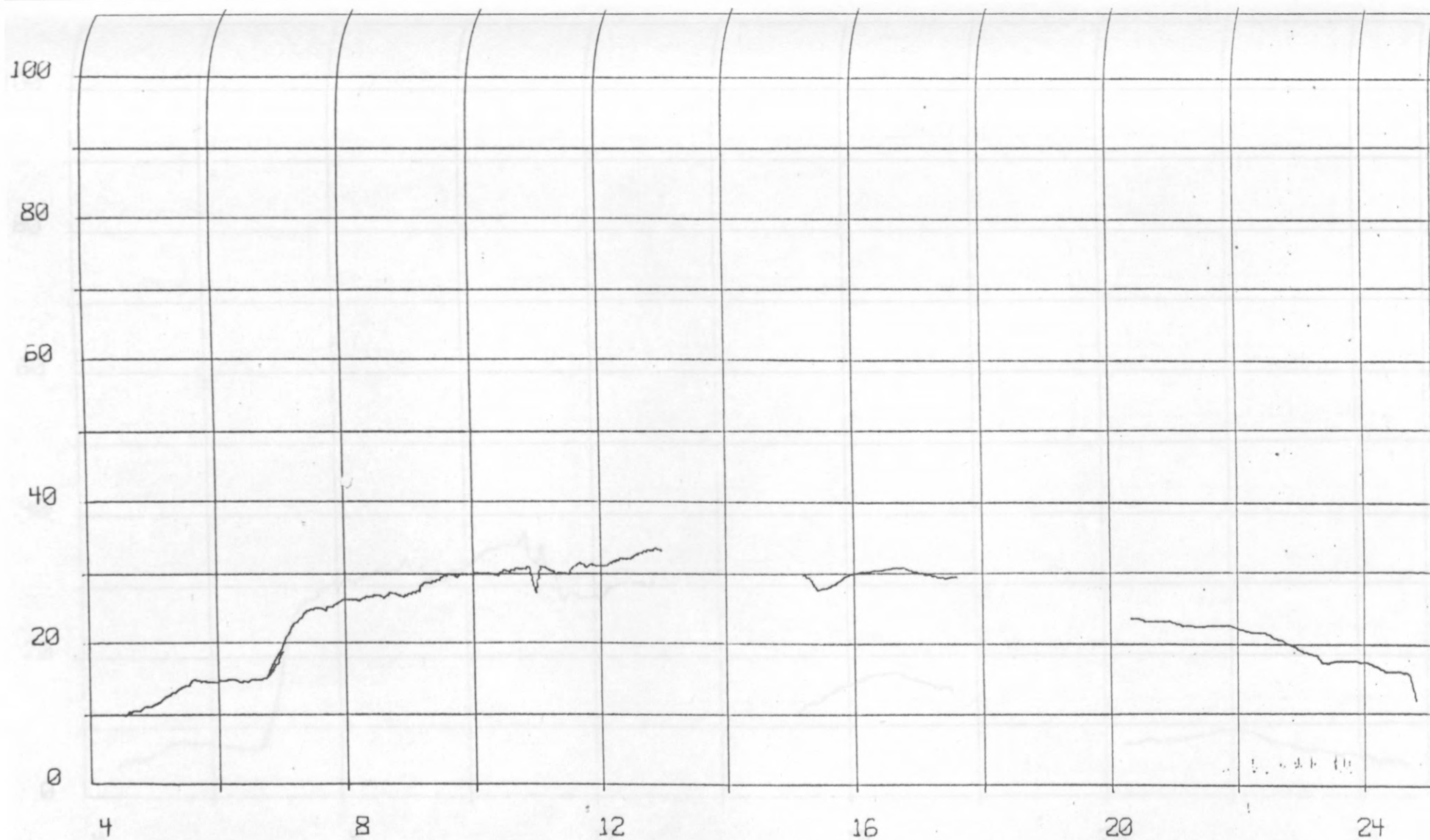
5 AUG 77

TINTIC, UTAH. TAPE (3) SITE: D-42/RABBIT BUSH

173/174

ABSOLUTE REFLECTANCE

Fig. 43 Chrysothamnus nauseosus



WAVELENGTH (TENTHS OF MICROMETERS)

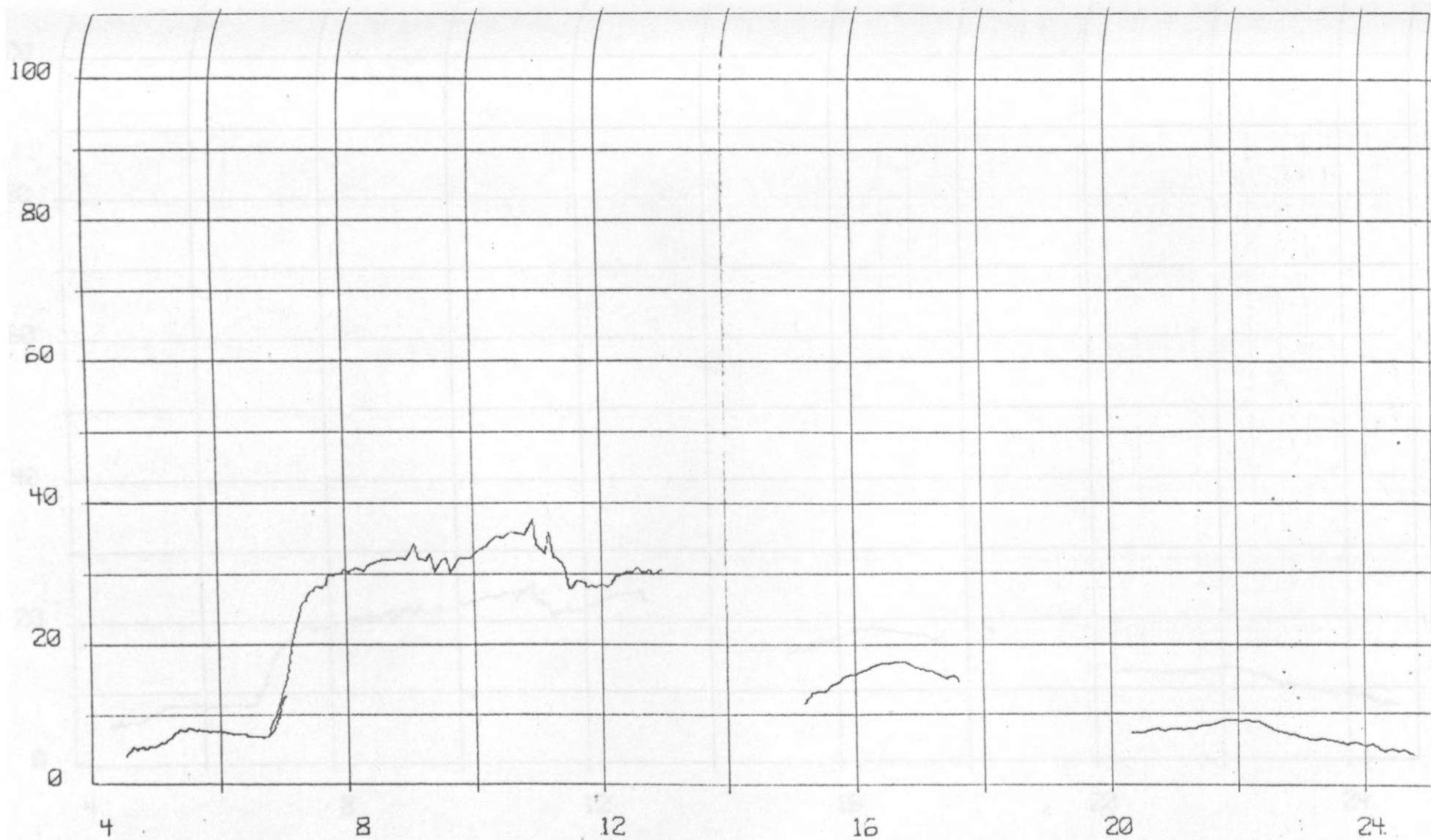
5 AUG 77

TINTIC, UTAH, TAPE (3) SITE: D-42/SOS W/OH250250

175/174

ABSOLUTE REFLECTANCE

Fig. 44 Chrysothamnus nauseosus



WAVELENGTH (TENTHS OF MICROMETERS)

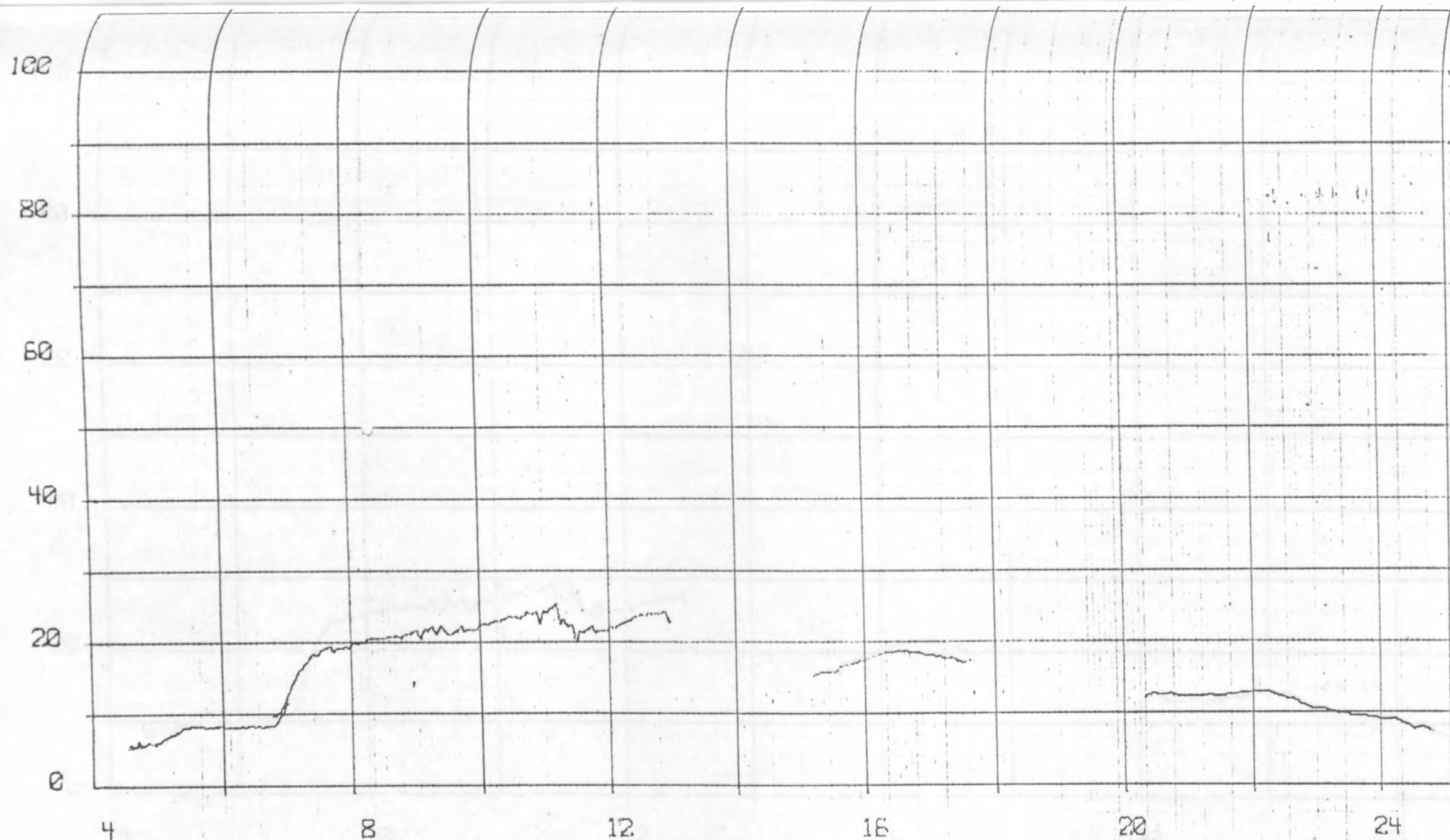
8 AUG 77

TINTIC, UTAH. TAPE (5B) SITE: A-18/RABBIT BRUSH

067/073

ABSOLUTE REFLECTANCE

Fig. 45 Chrysothamnus nauseosus



WAVELENGTH (TENTHS OF MICROMETERS)

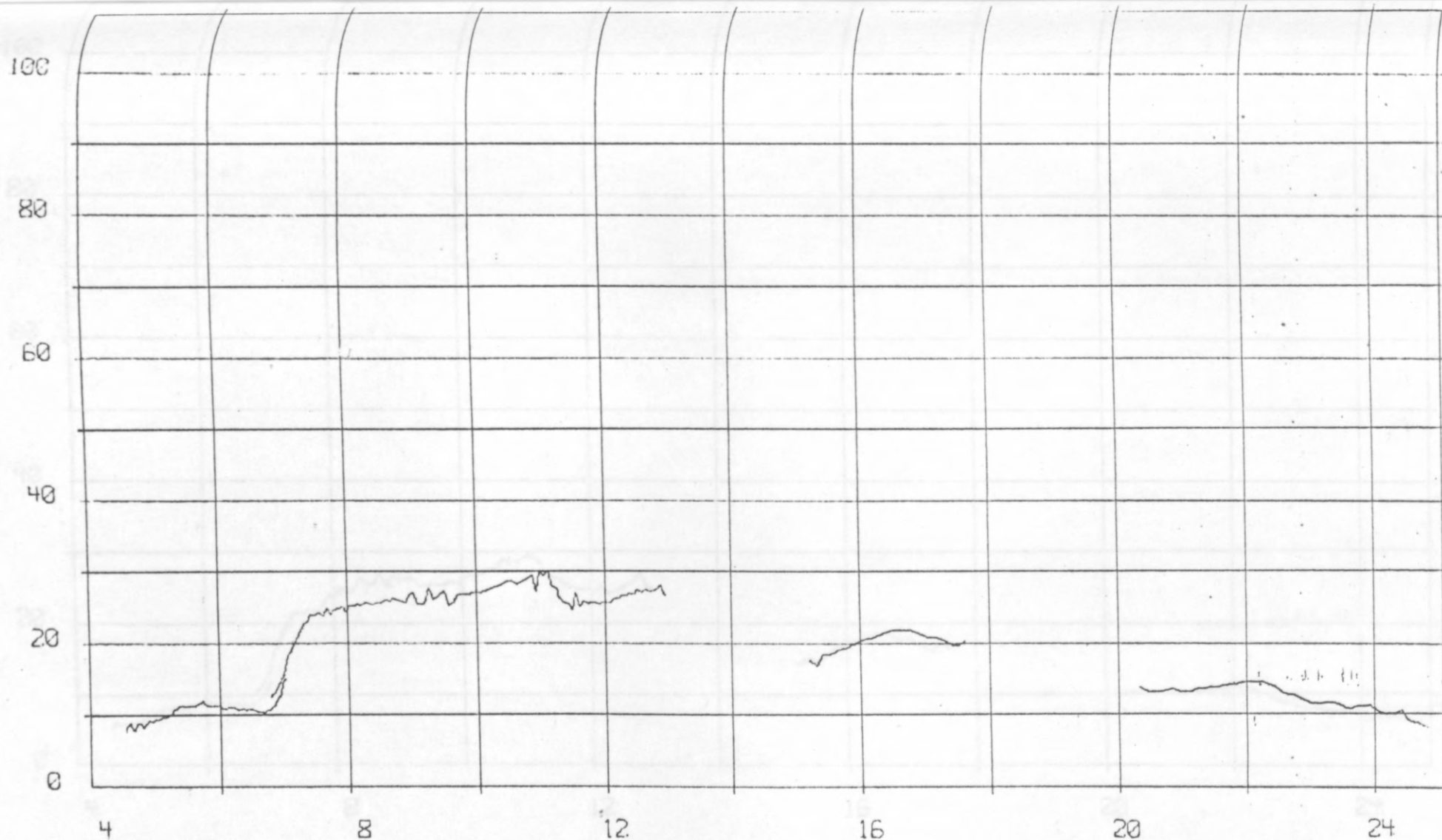
9 AUG '77

TINTIC, UTAH, TAPE (8) SITE: B-27/RABBIT BRUSH

153/155

ABSOLUTE REFLECTANCE

Fig. 46 Chrysothamnus nauseosus



WAVELENGTH (TENTHS OF MICROMETERS)

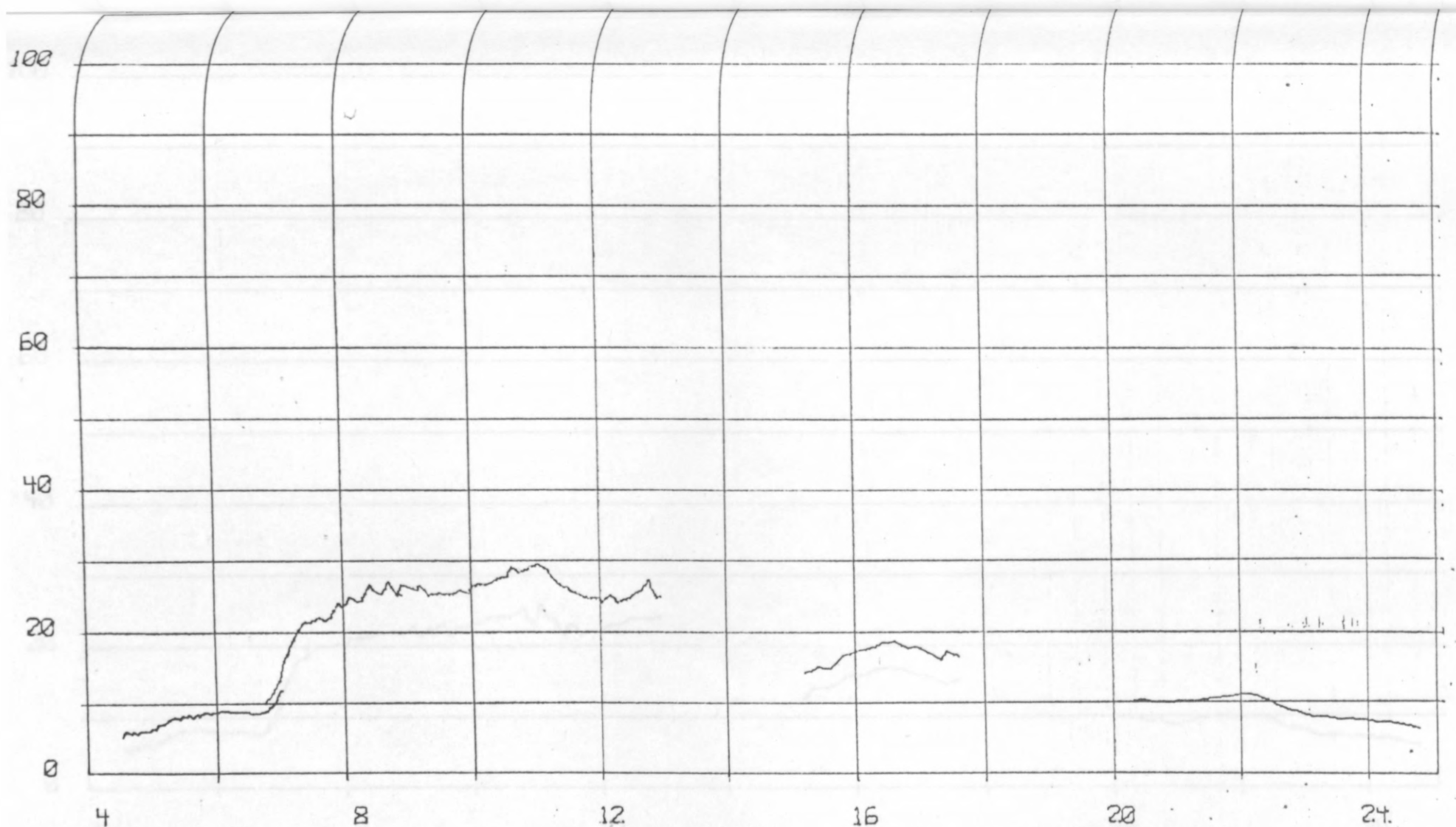
7 AUG 77

TINTIC, UTAH, TAPE (4) SITE: D-44/RABBIT BRUSH

224/225

ABSOLUTE REFLECTANCE

Fig. 47 Chrysothamnus nauseosus



WAVELENGTH (TENTHS OF MICROMETERS)

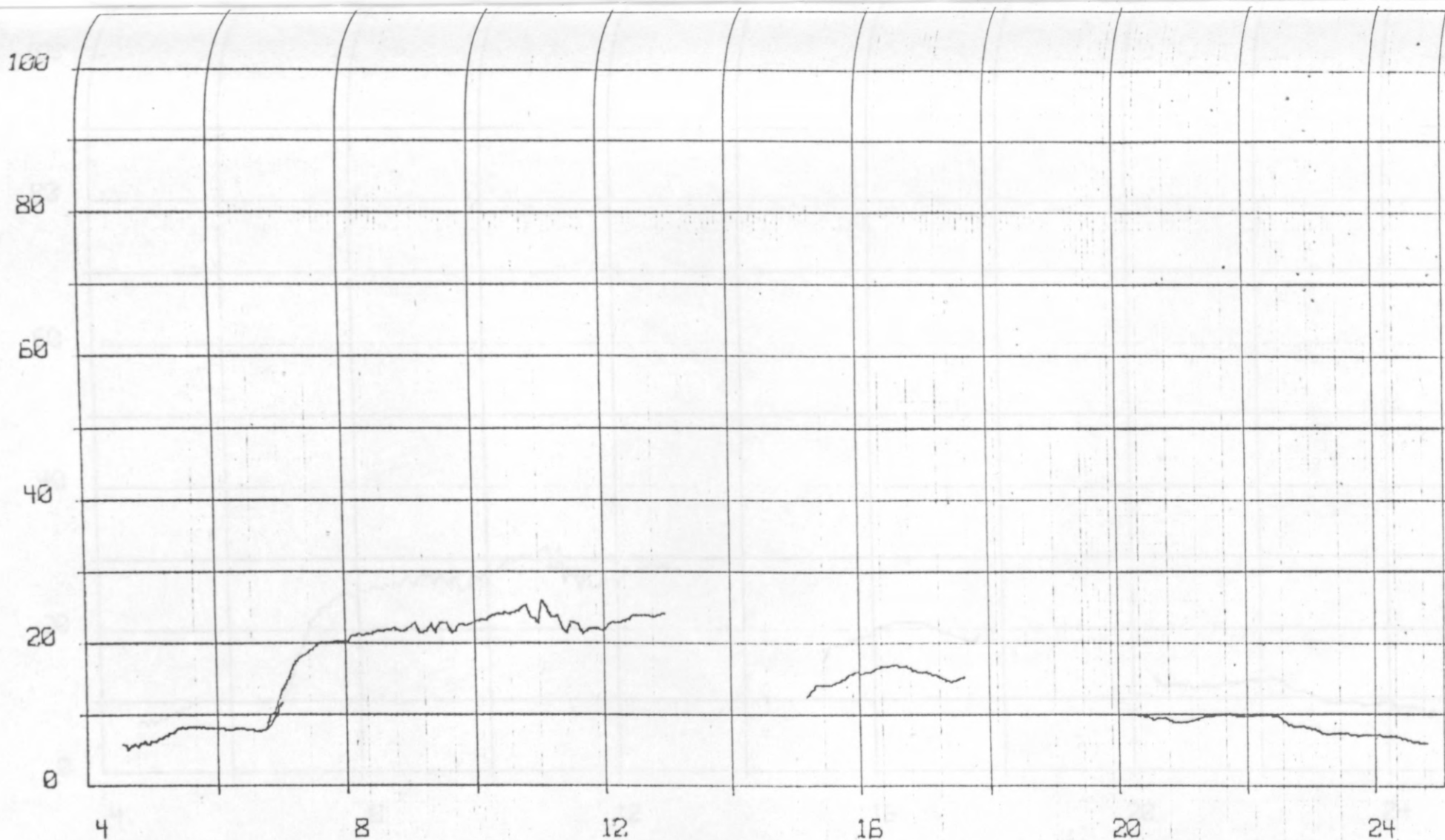
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: D-69/RABBIT BUSH

301/303

ABSOLUTE REFLECTANCE

Fig. 48 *Chrysothamnus nauseosus*



WAVELENGTH (TENTHS OF MICROMETERS)

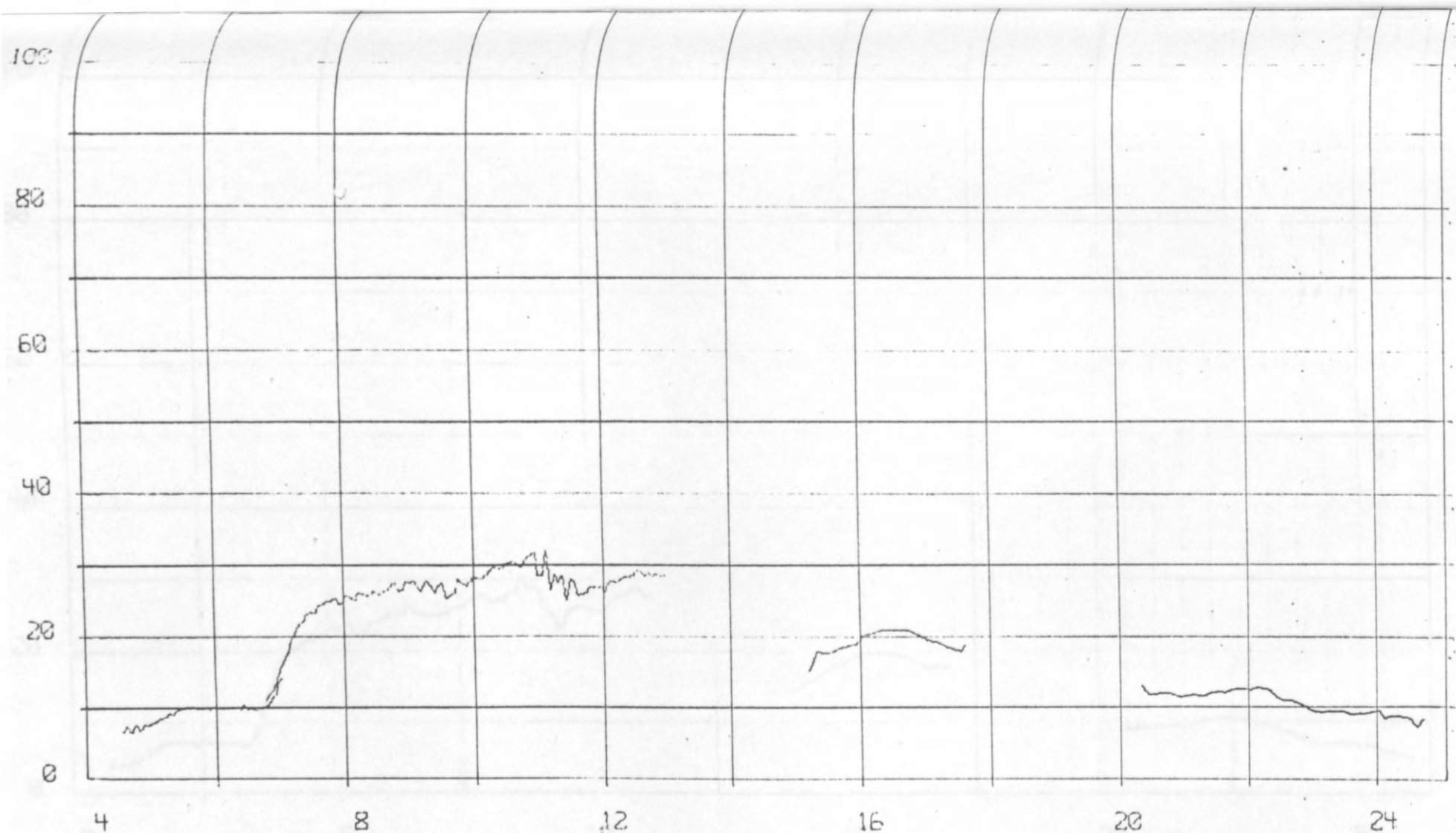
9 AUG 77

TINTIC, UTAH, TAPE ⁹(10) SITE: G-97/RABBIT BUSH

255/257

ABSOLUTE REFLECTANCE

Fig. 49 Chrysothamnus nauseosus



WAVELENGTH (TENTHS OF MICROMETERS)

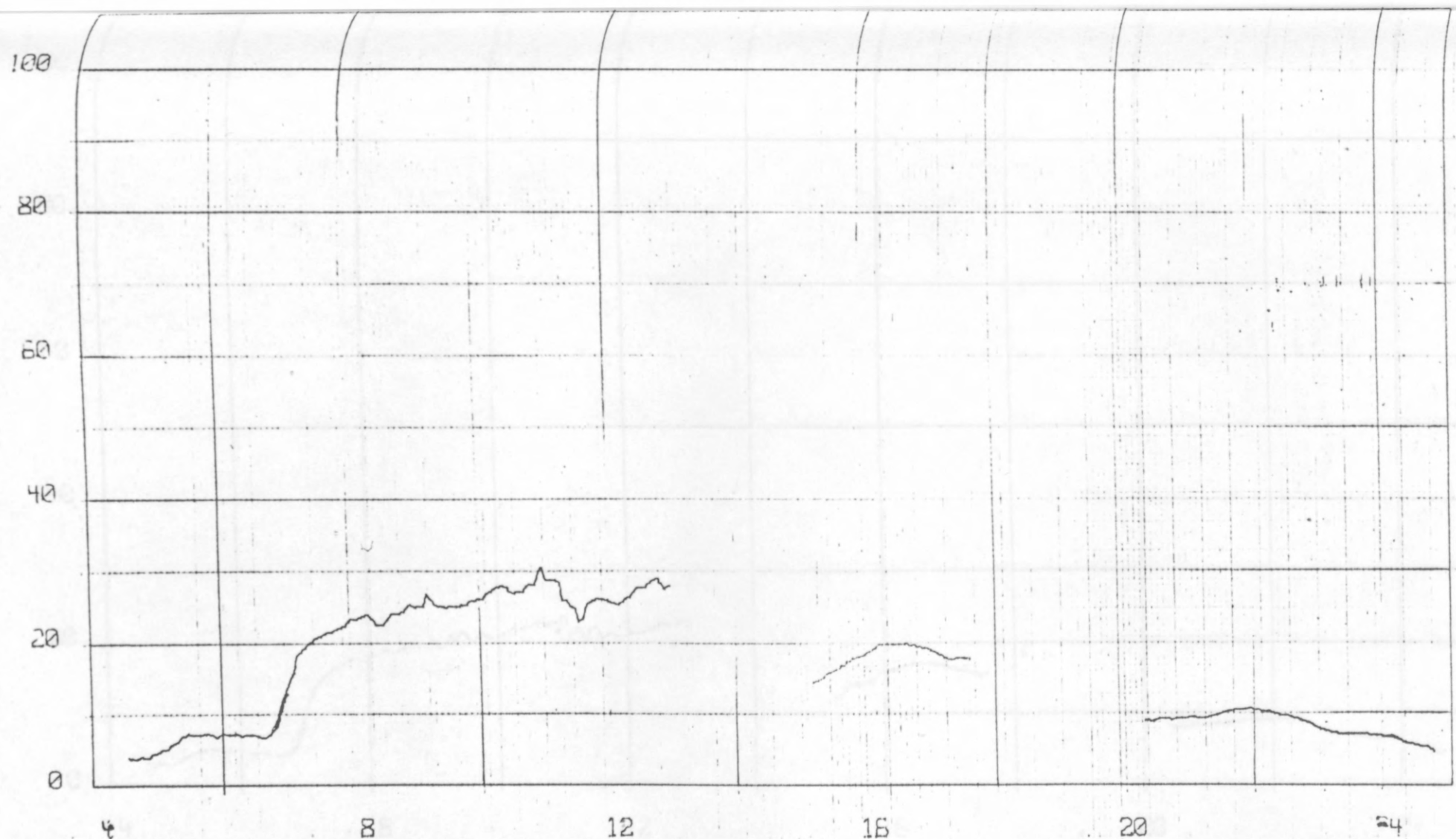
7 AUG 77

TINTIC, UTAH, TAPE (4) SITE: F-69/RABBIT BRUSH

330/331

ABSOLUTE REFLECTANCE

Fig. 50 Chrysothamnus nauseosus



WAVELENGTH (TENTHS OF MICROMETERS)

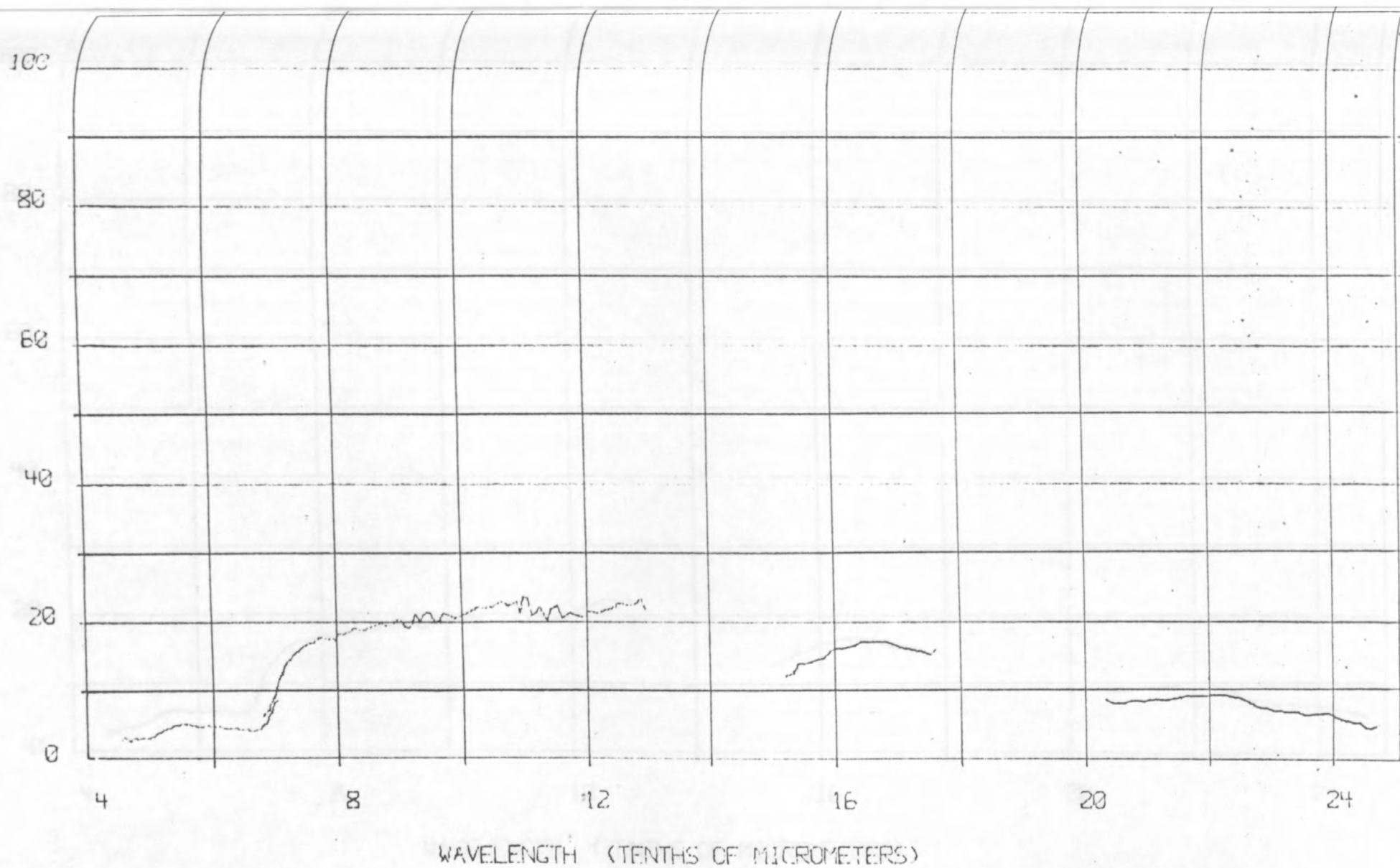
9 AUG '77

TINTIC, UTAH, TAPE ⁹(10) SITE: D-56/RABBIT BUSH W/

011/013

ABSOLUTE REFLECTANCE

Fig. 51 Chrysothamnus viscidiflorus



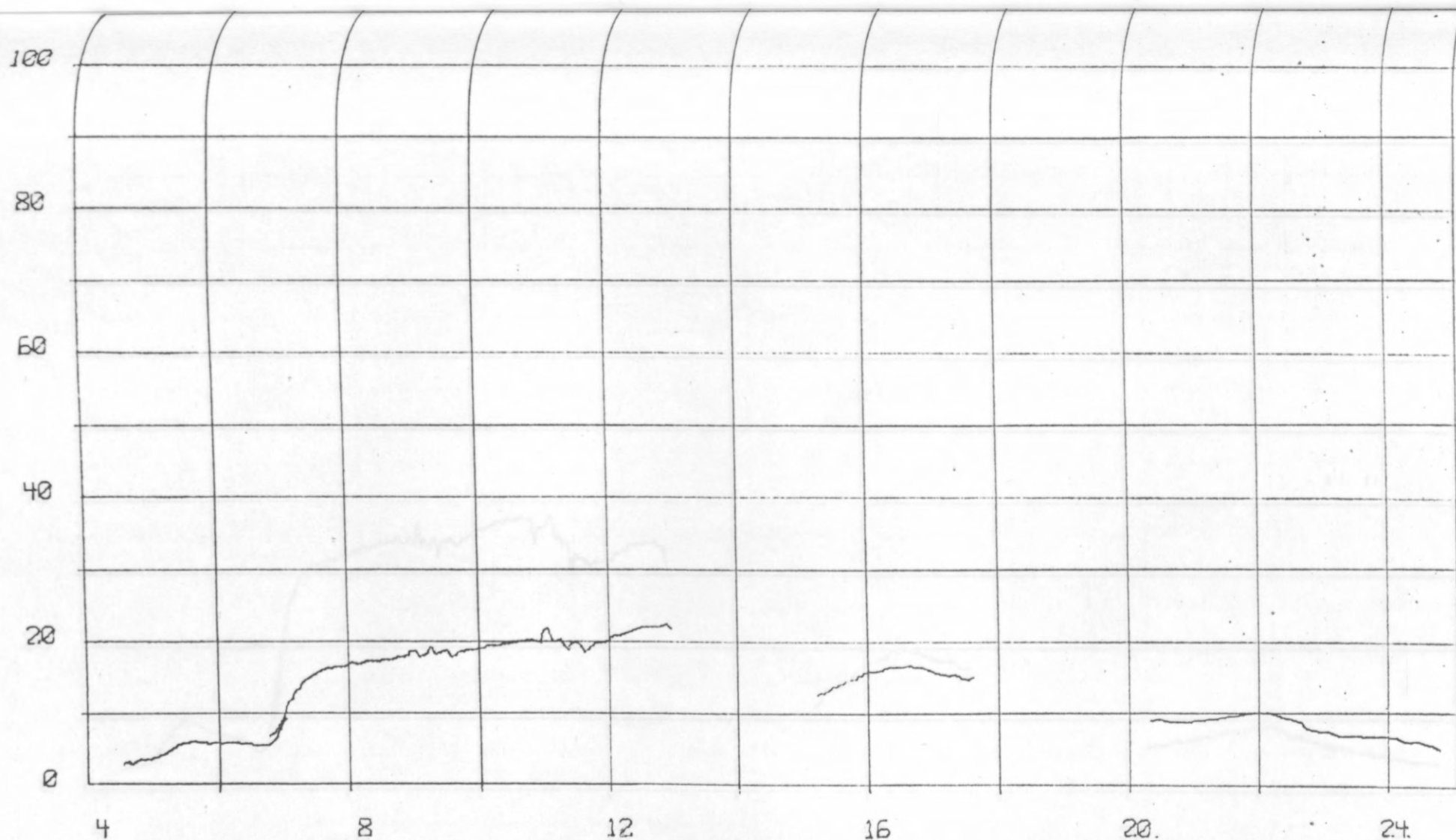
7 AUG 77

TINTIC, UTAH, TAPE (4) SITE: D-55/CHRY. VISCID.

256/257

ABSOLUTE REFLECTANCE

Fig. 52 Chrysothamnus viscidiflorus



WAVELENGTH (TENTHS OF MICROMETERS)

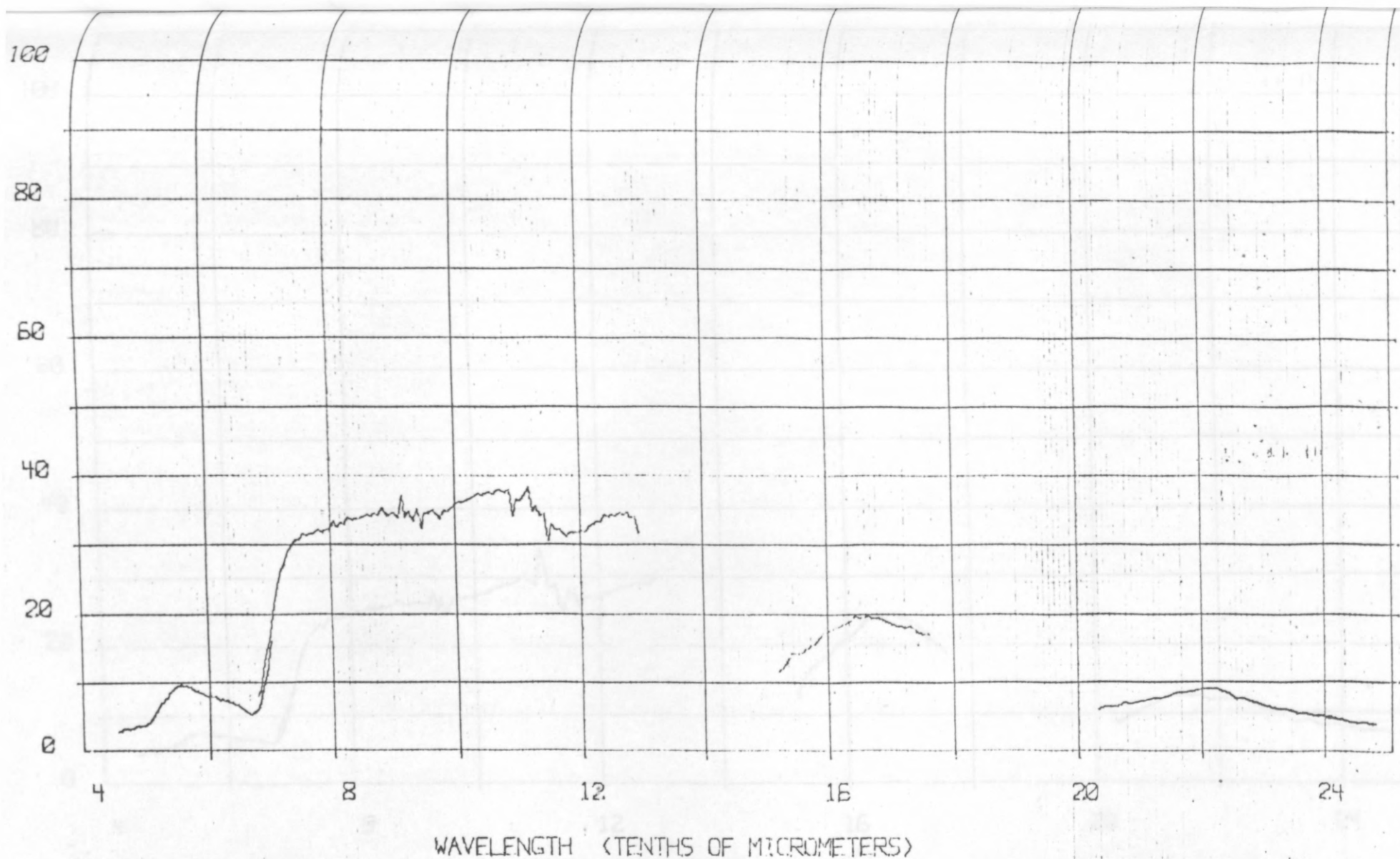
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: D-70/RABBIT BRUSH*

305/307

ABSOLUTE REFLECTANCE

Fig. 53 Chrysothamnus viscidiflorus



WAVELENGTH (TENTHS OF MICROMETERS)

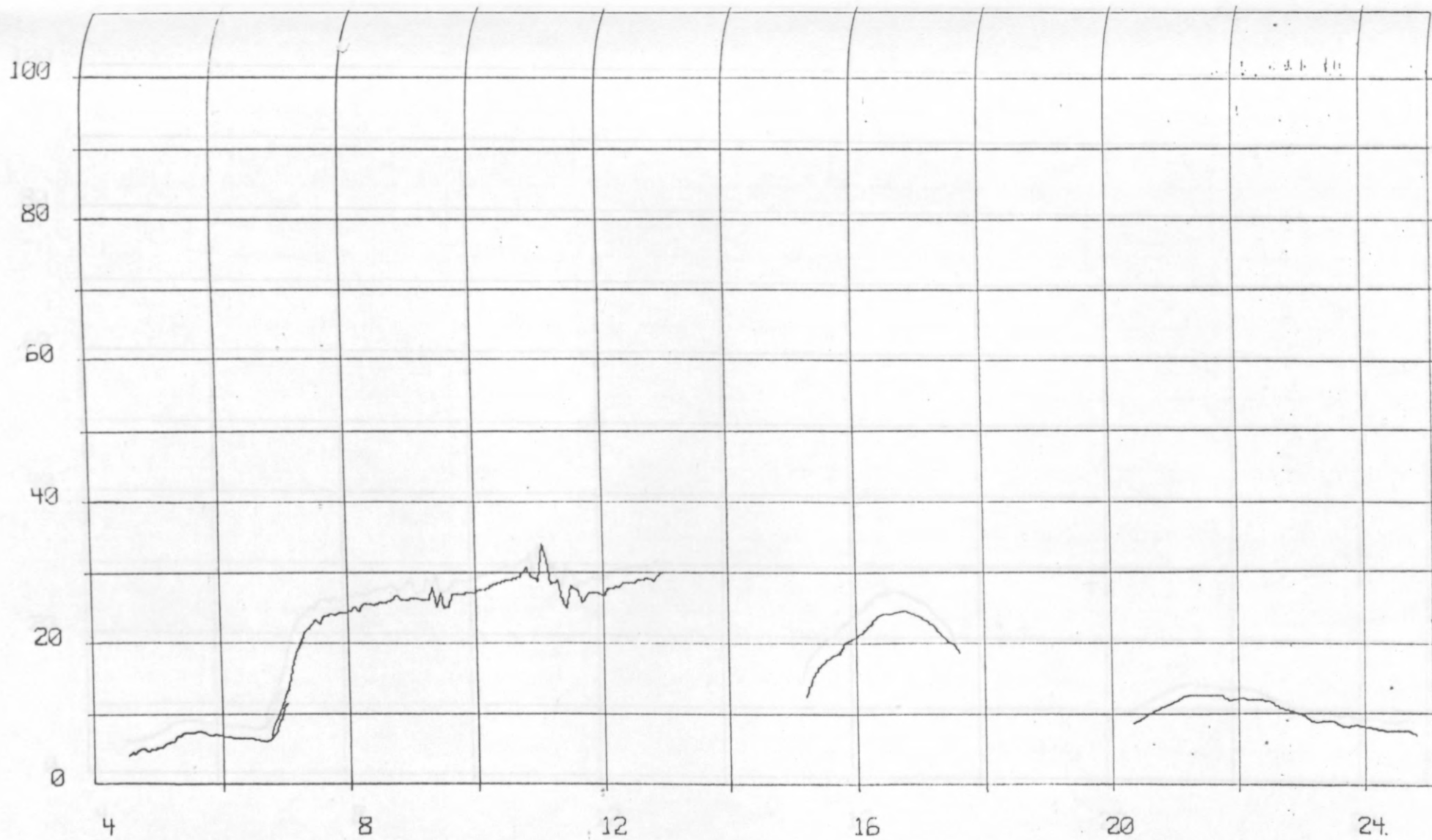
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: B-28/RABBIT BRUSH

157/155

ABSOLUTE REFLECTANCE

Fig. 54 Chrysothamnus viscidiflorus



WAVELENGTH (TENTHS OF MICROMETERS)

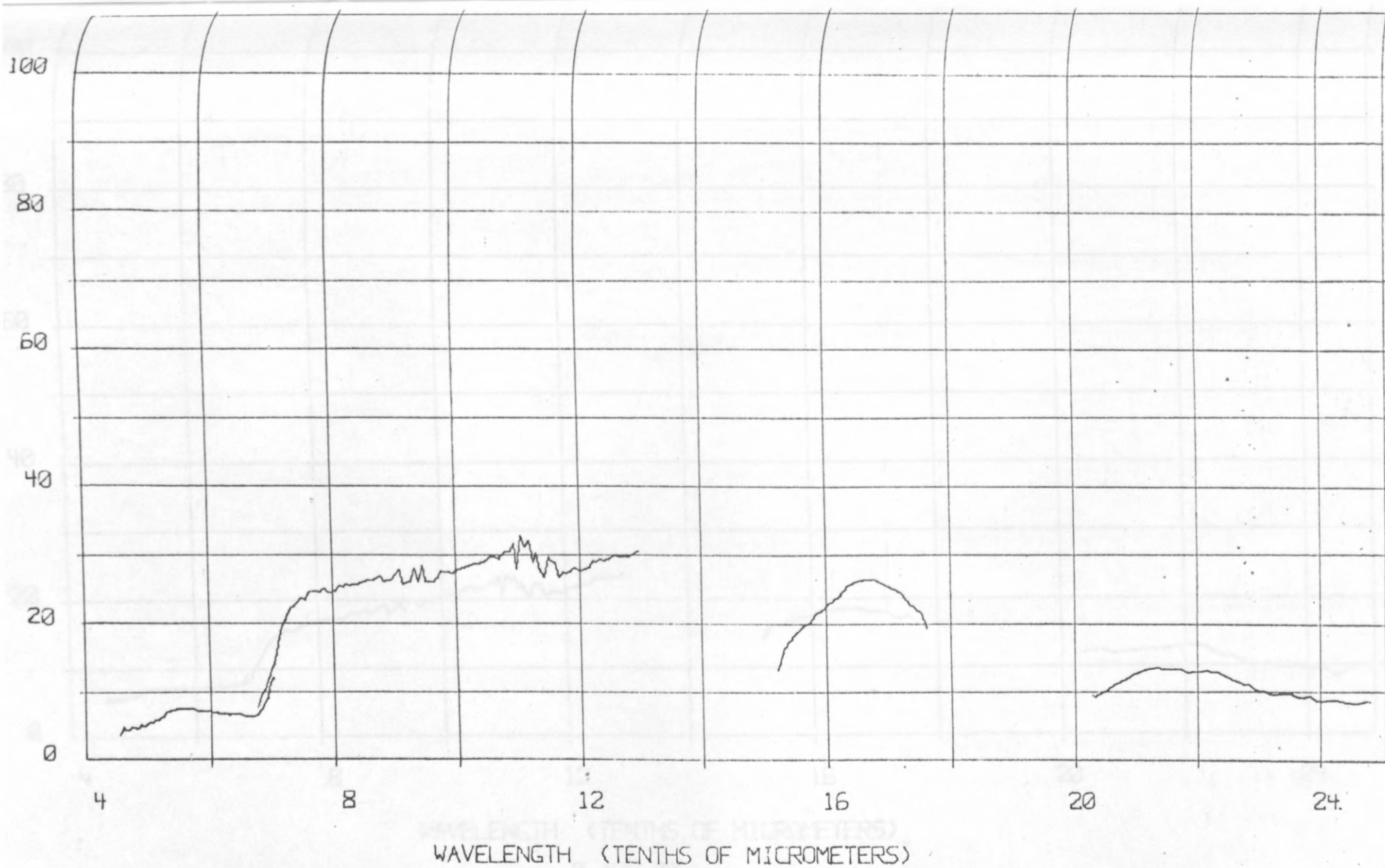
5 AUG 77

TINTIC, UTAH, TAPE (3) SITE: D-40/ANTELOPE BUSH

165/166

ABSOLUTE REFLECTANCE

Fig. 55 Purshia tridentata



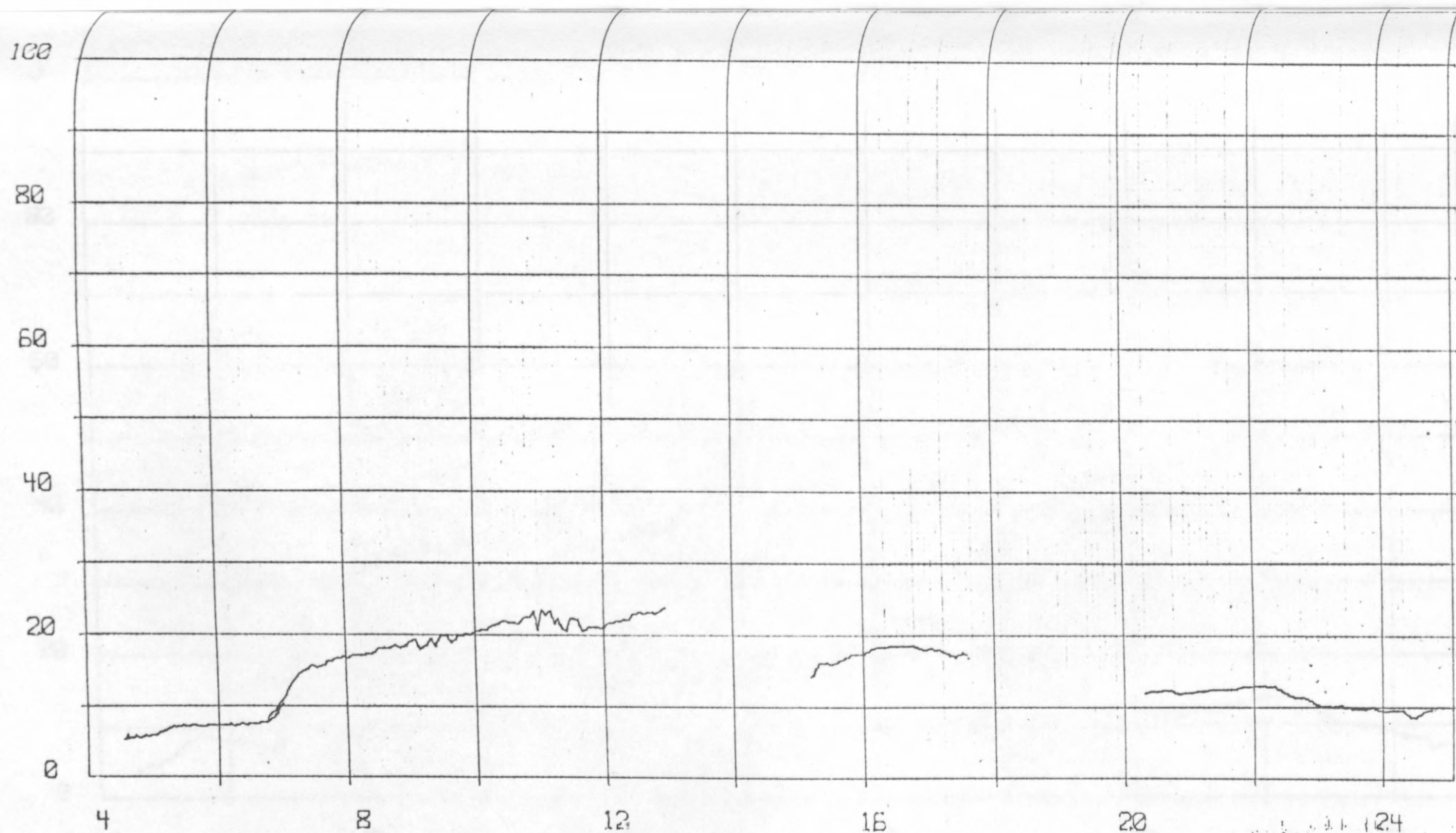
5 AUG 77

TINTIC, UTAH, TAPE (3) SITE: D-40/50B W/OHB

167/166

ABSOLUTE REFLECTANCE

Fig. 56 Purshia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

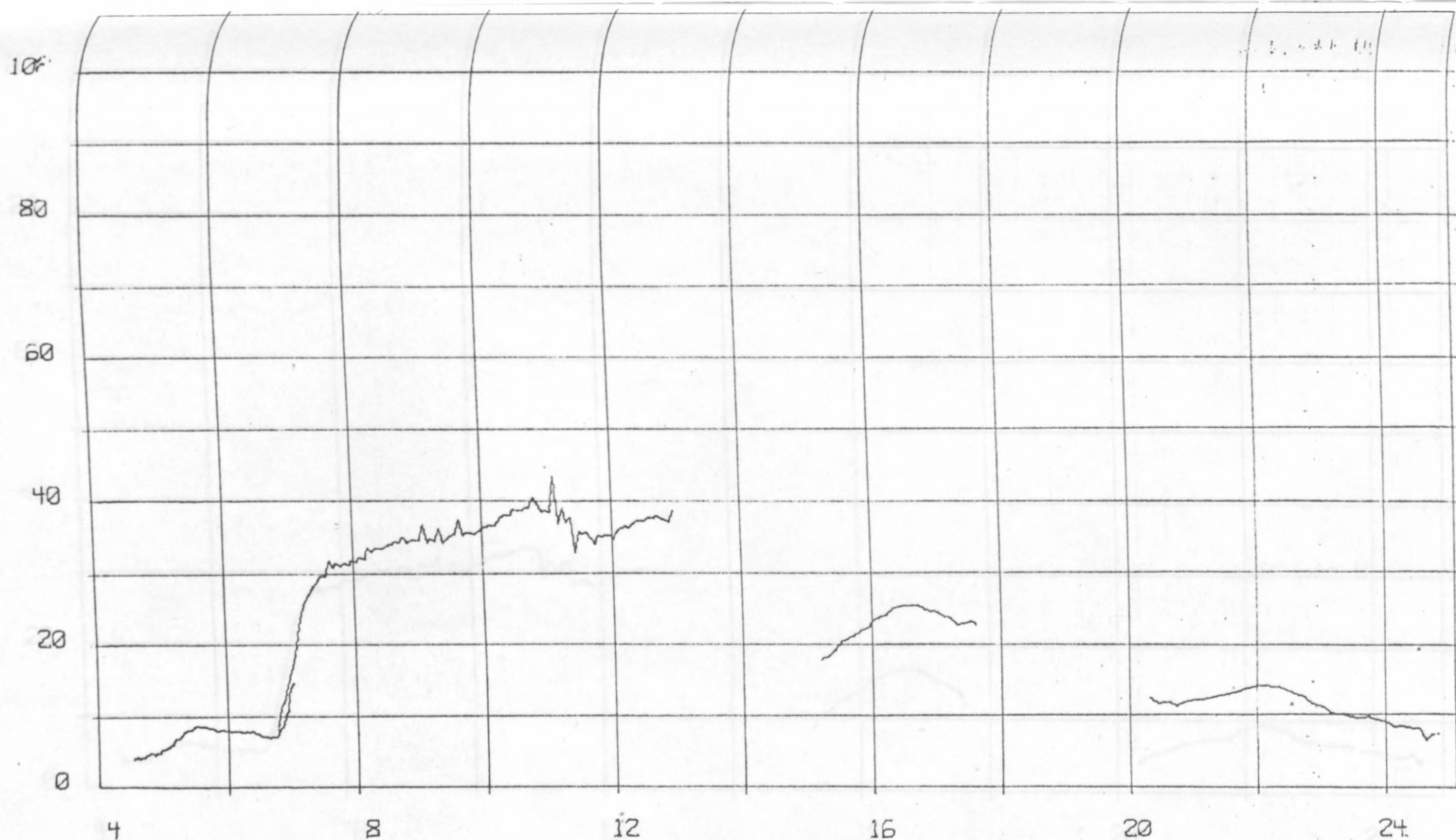
8 AUG 77

TINTIC, UTAH, TAPE (7) SITE: F-102/ANTELOPE BUSH

163/165

ABSOLUTE REFLECTANCE

Fig. 57 Purshia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

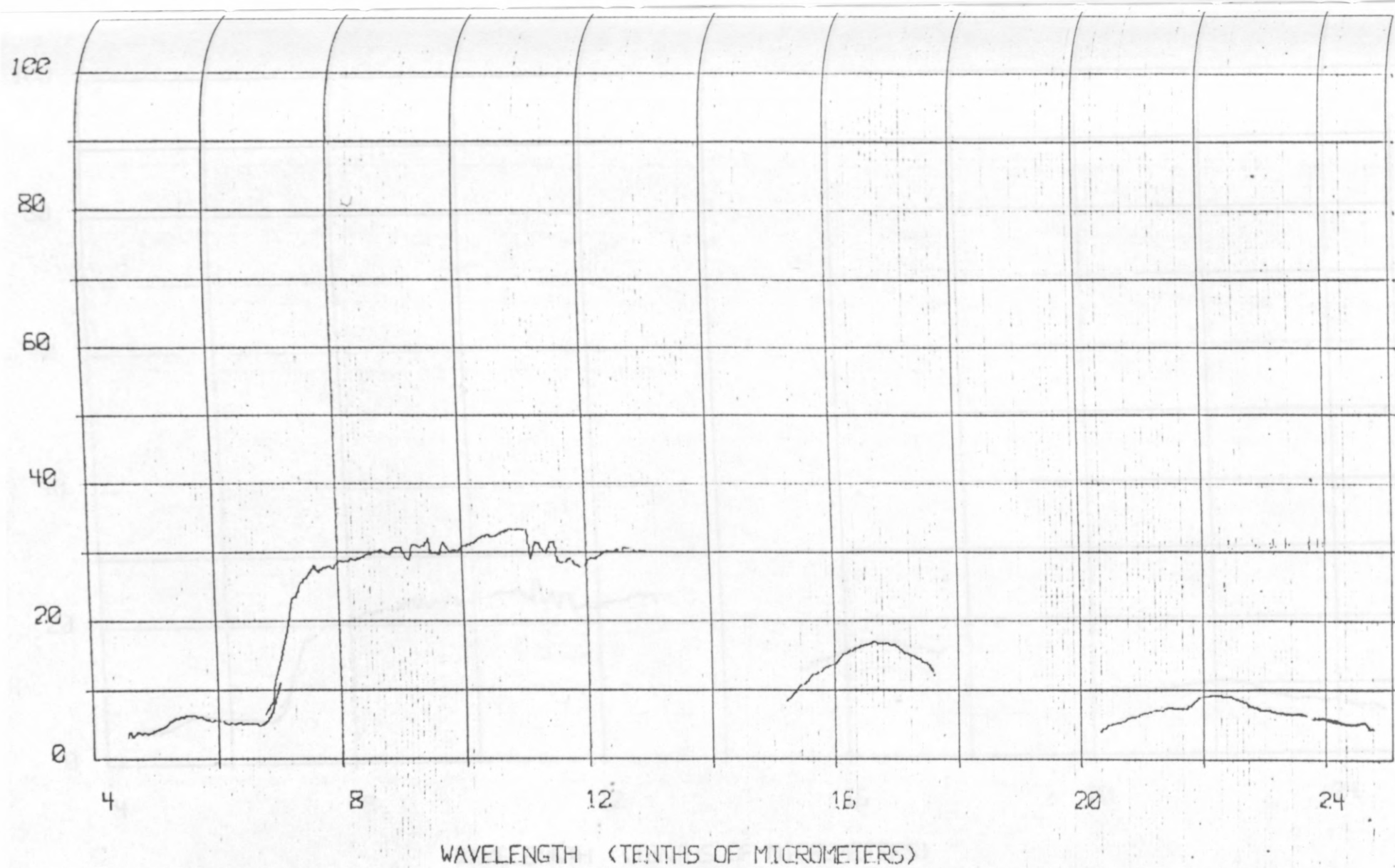
8 AUG 77

TINTIC, UTAH, TAPE (5B) SITE: A-8/ANTELOPE BUSH

023/024

ABSOLUTE REFLECTANCE

Fig. 58 Purshia tridentata



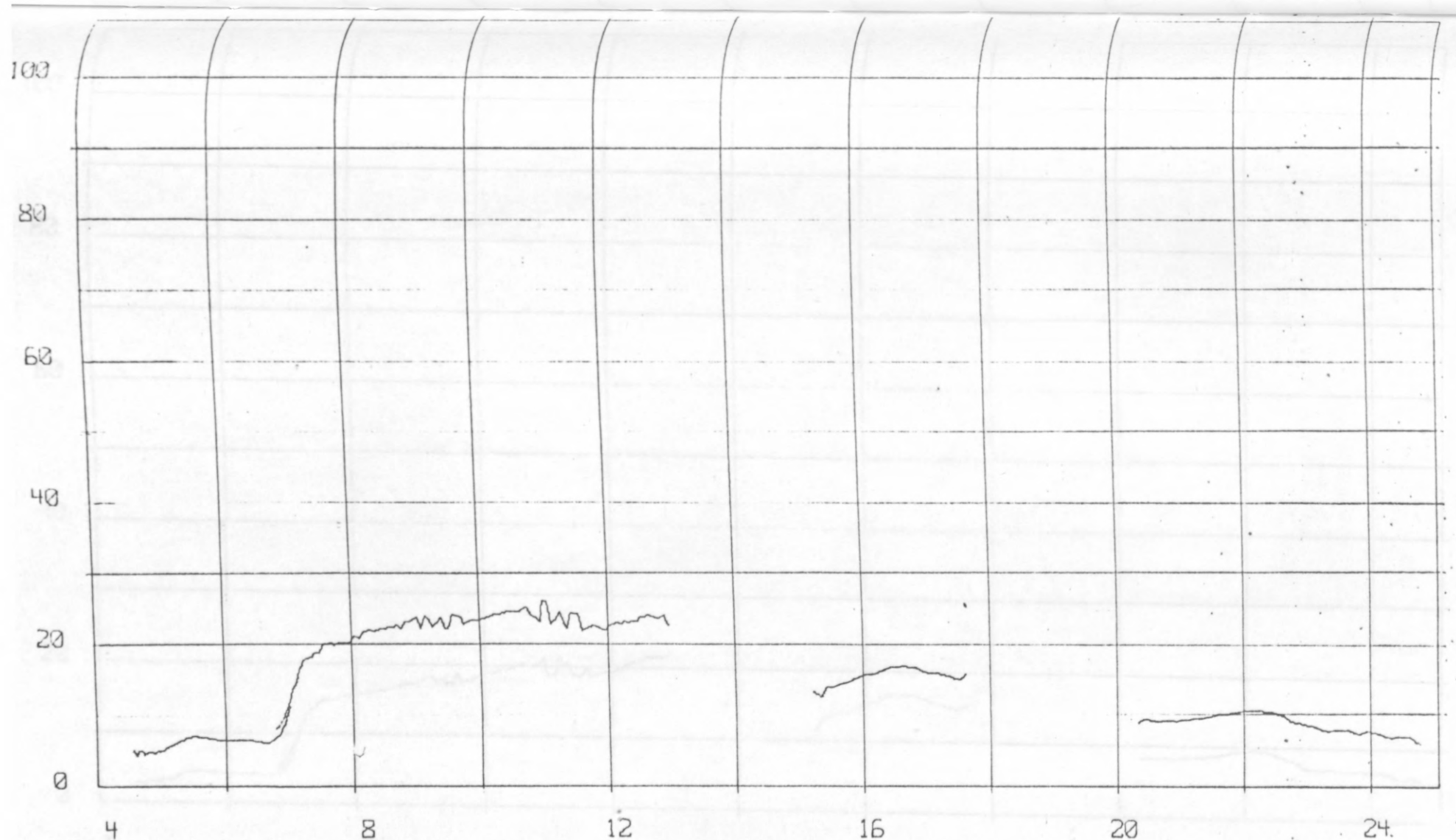
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: B-26/ANTELOPE BRUSH

147/151

ABSOLUTE REFLECTANCE

Fig. 59 Purshia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

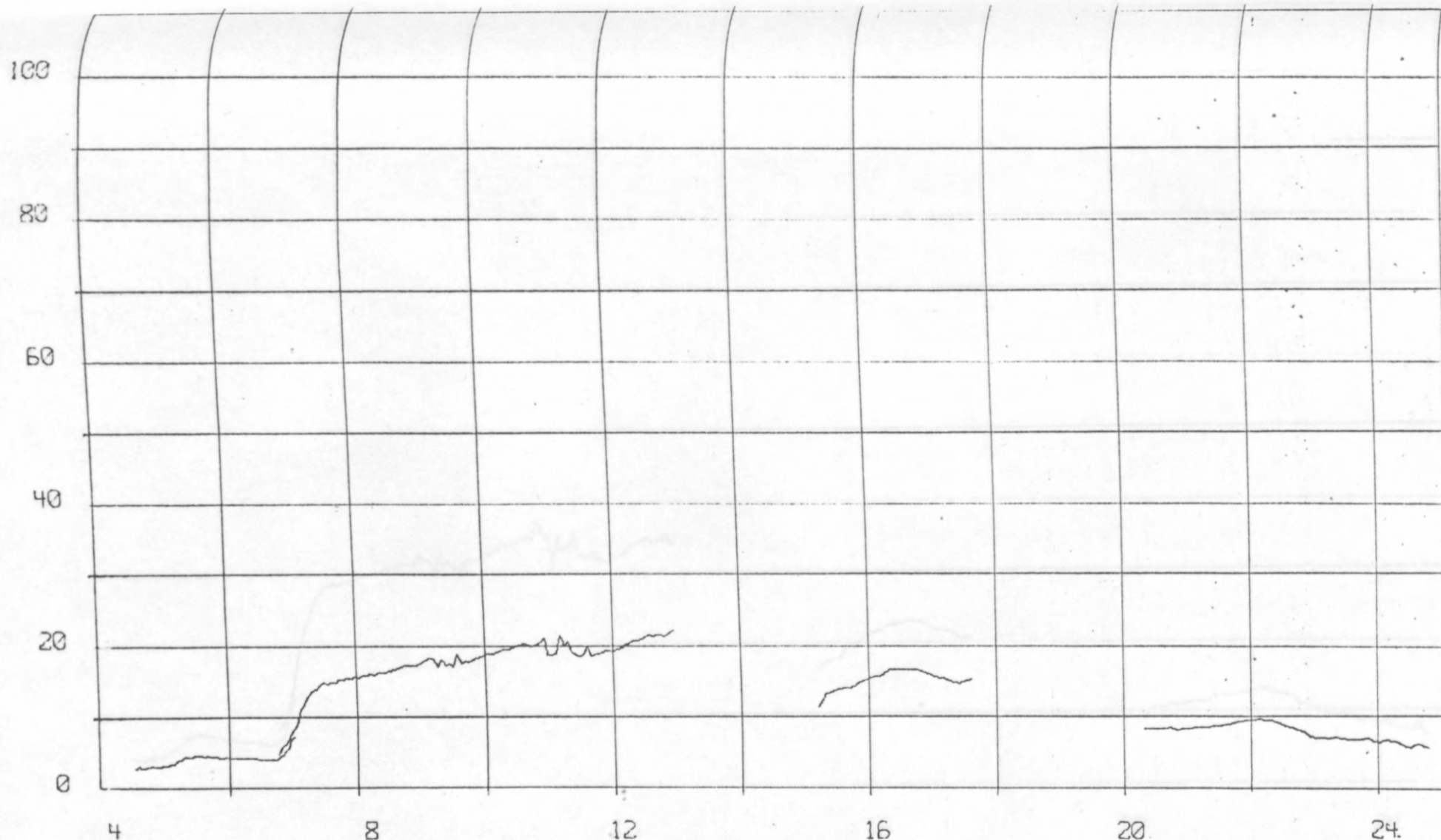
3 AUG 77

TINTIC, UTAH, TAPE (1) SITE: D-42/P, TRIDENTATA

140/141

ABSOLUTE REFLECTANCE

Fig. 60 Purshia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

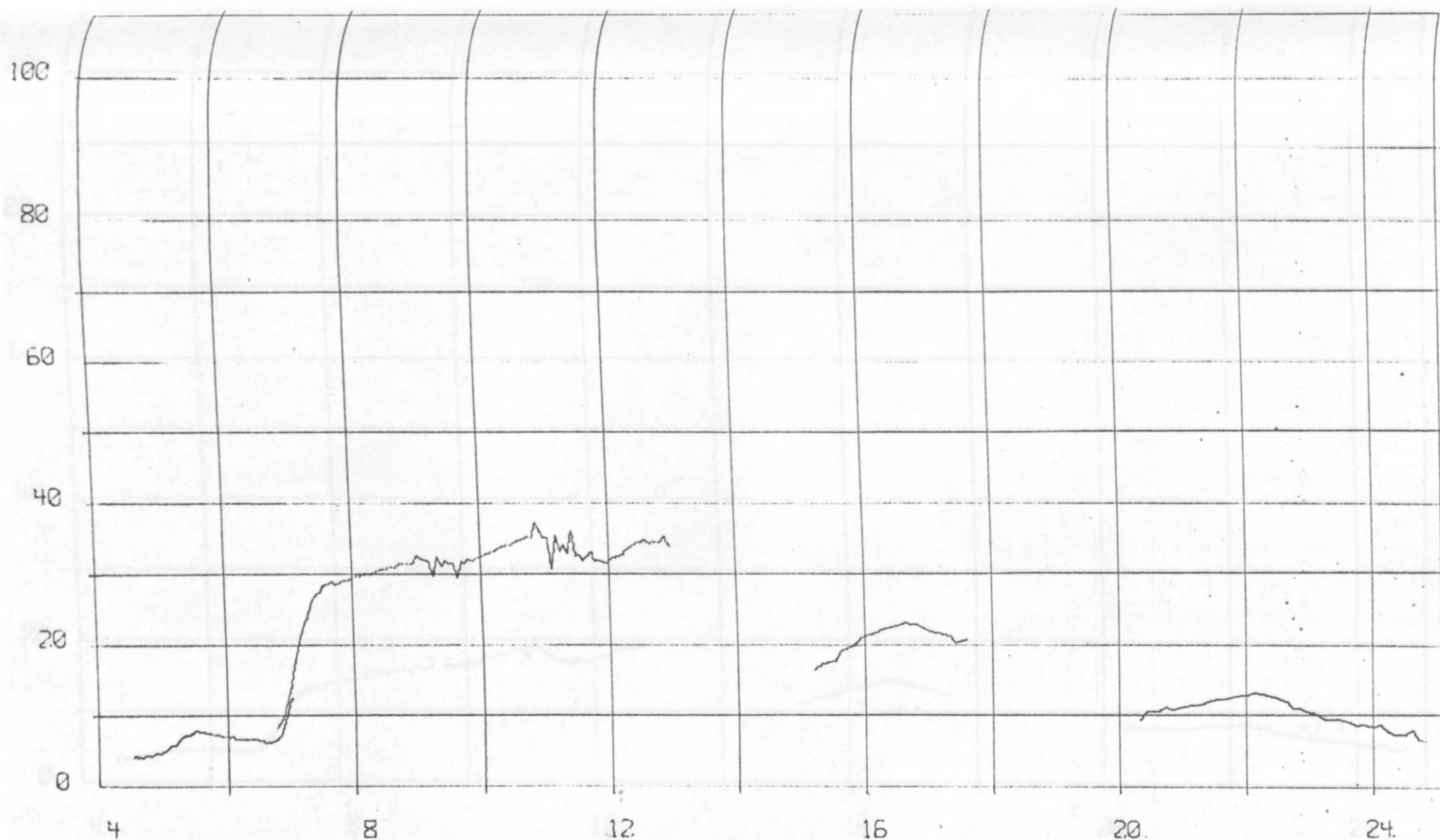
7 AUG 77

TINTIC, UTAH, TAPE (4) SITE: B-25/LOW ANTELOPE B

150/151

ABSOLUTE REFLECTANCE

Fig. 61 Purshia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

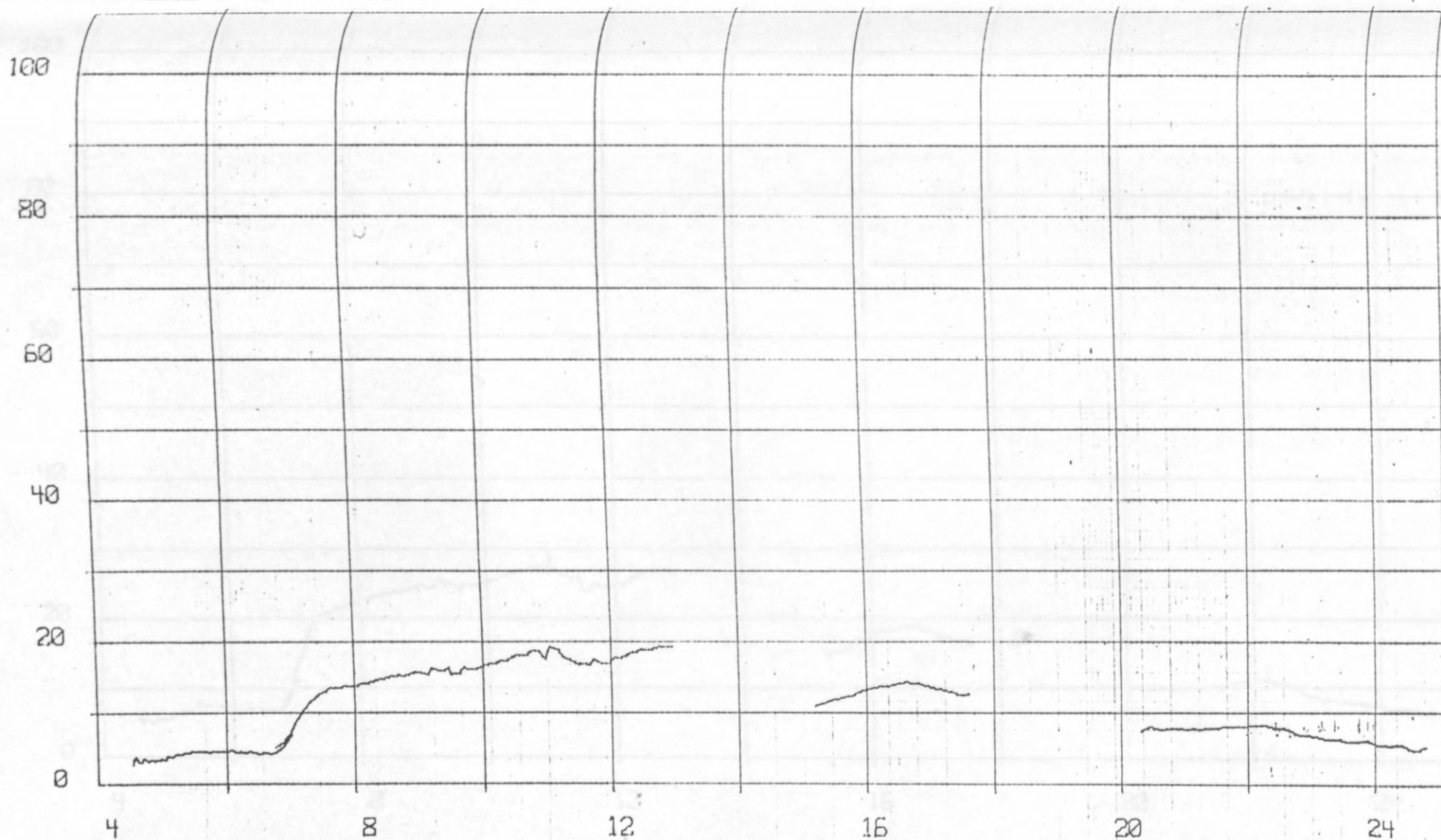
7 AUG 77

TINTIC, UTAH, TAPE (4) SITE: C-30/LUSH ANTELOPE

163/164

ABSOLUTE REFLECTANCE

Fig. 62 Purshia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

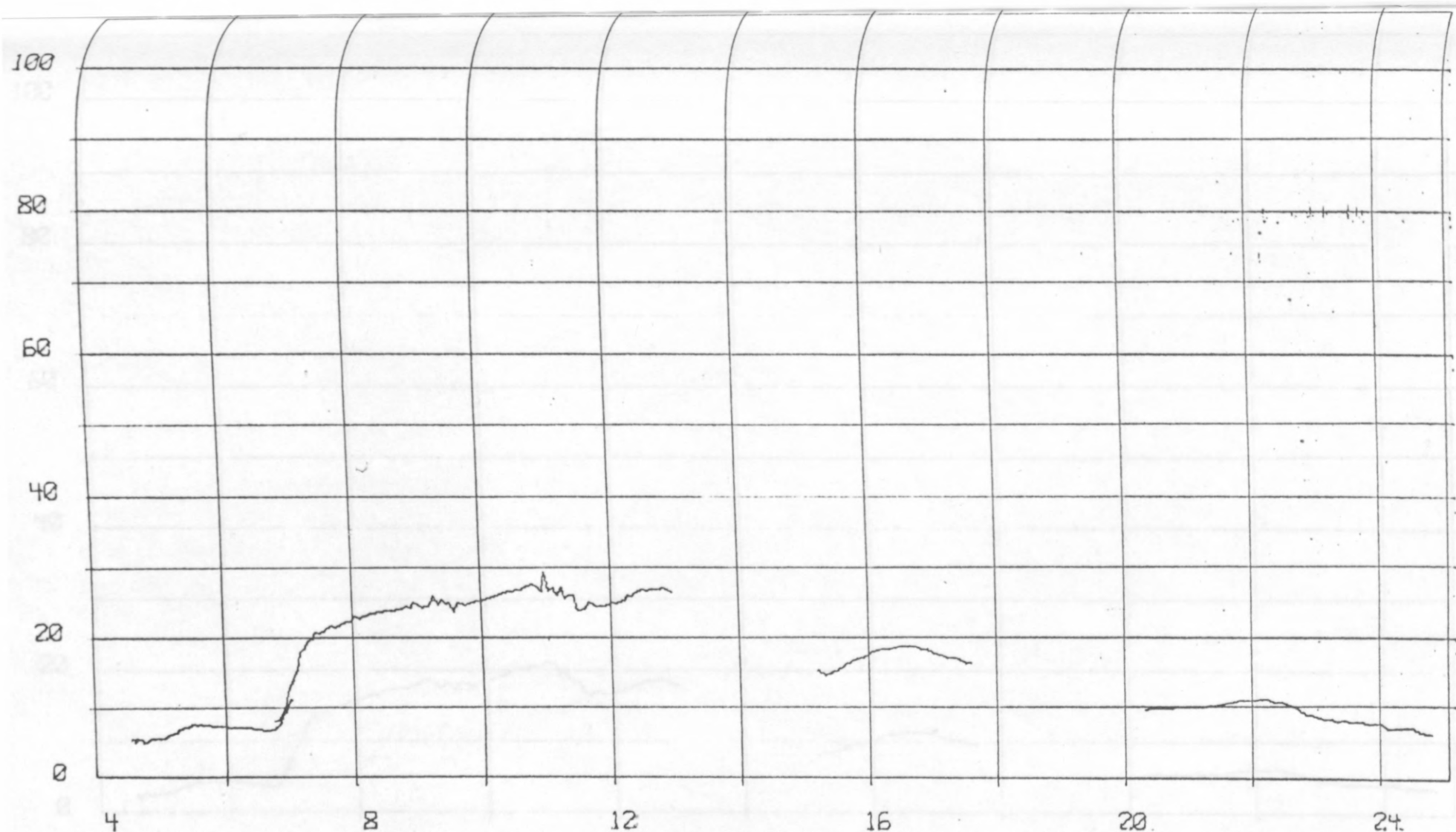
9 AUG 77

TINTIC, UTAH. TAPE ⁹(10) SITE: F-80/ANTELOPE BUSH

151/153

ABSOLUTE REFLECTANCE

Fig. 63 Purshia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

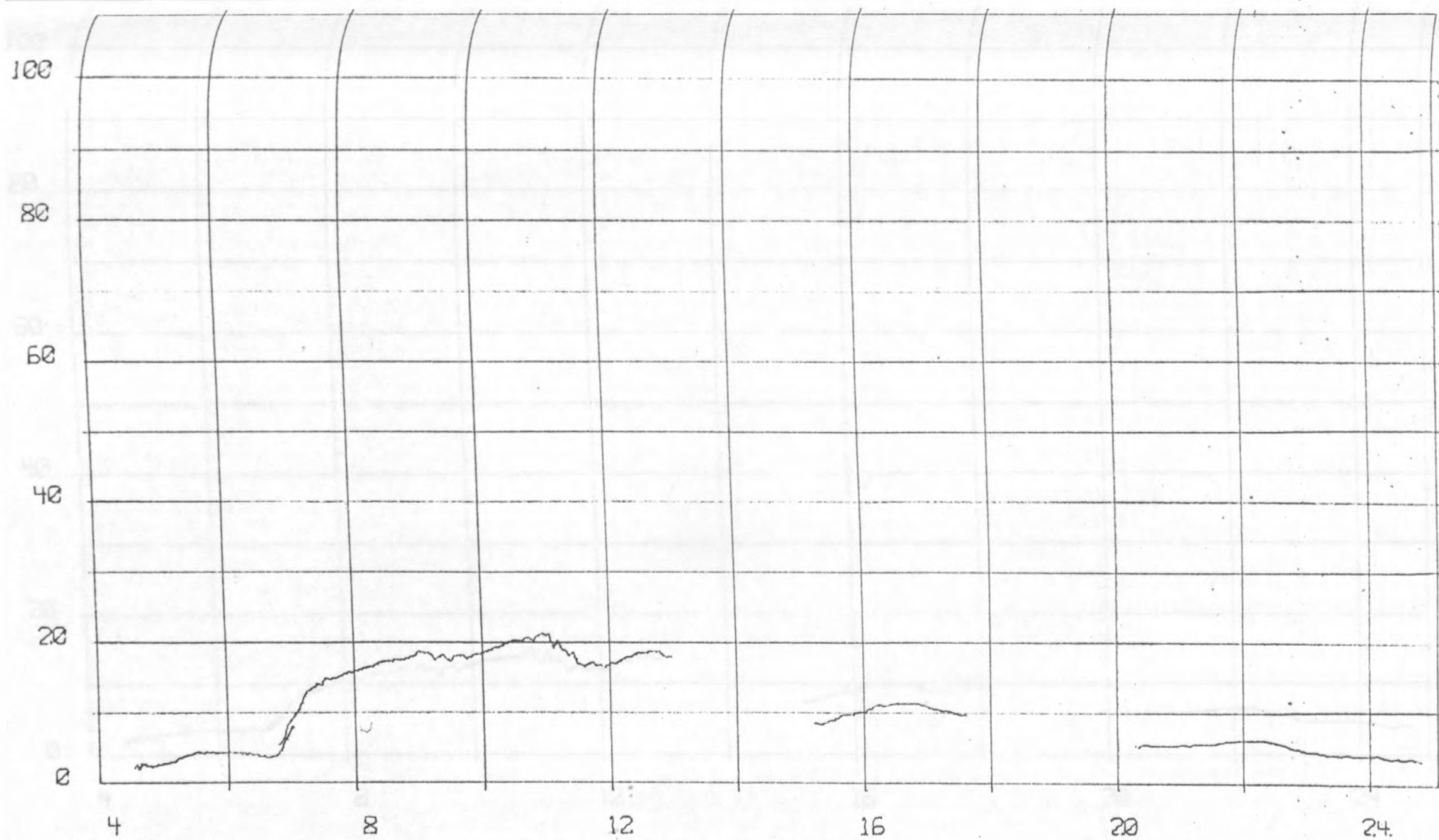
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: D-62/ANTELOPE BUSH

237/241

ABSOLUTE REFLECTANCE

Fig. 64 Purshia tridentata



WAVELENGTH (TENTHS OF MICROMETERS)

S.W. N. Stand.

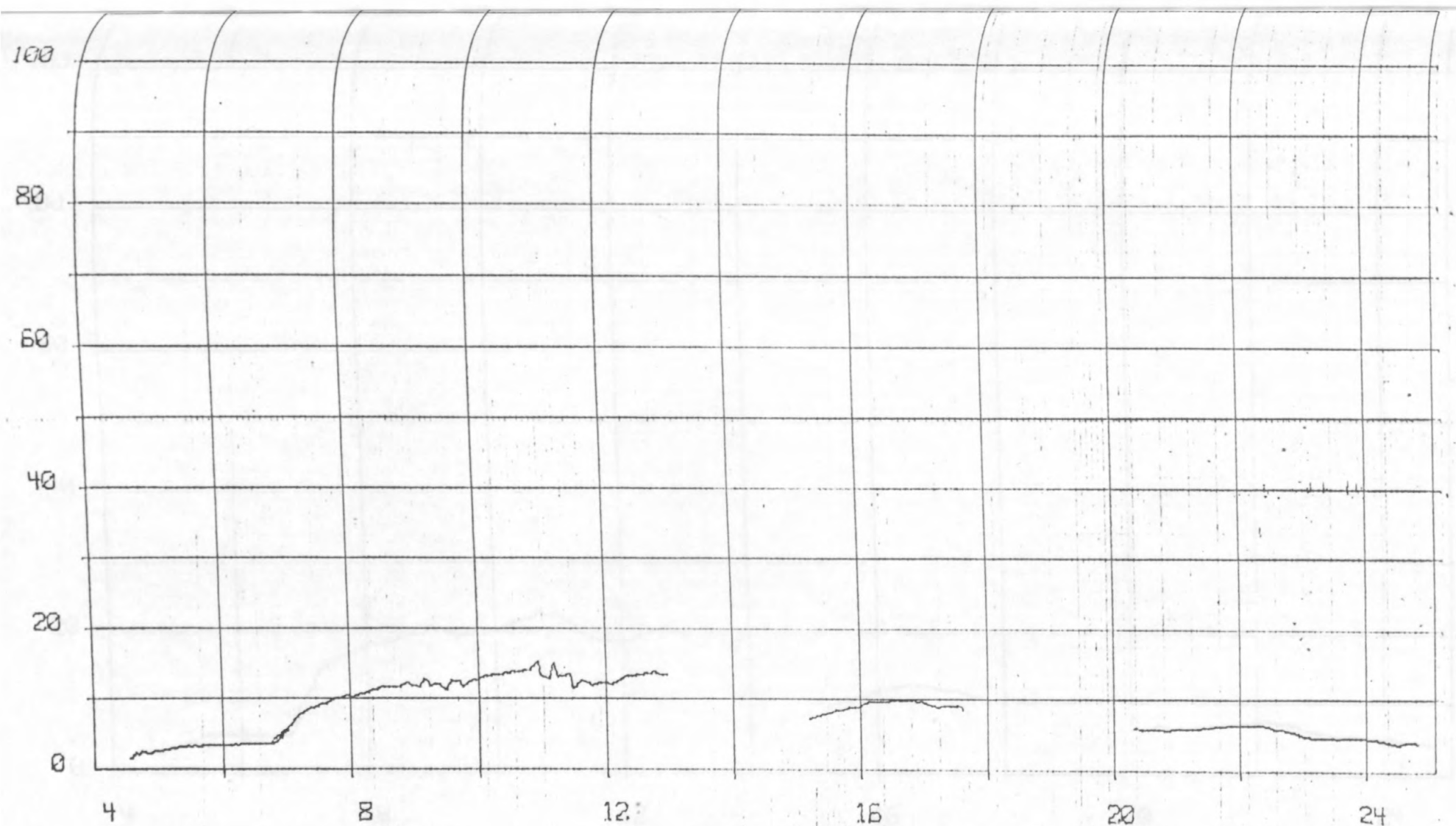
8 AUG 77

TINTIC, UTAH, TAPE (7) SITE: E-78/MORMON TEA

005/007

ABSOLUTE REFLECTANCE

Fig. 65 *Ephedra viridis*



WAVELENGTH (TENTHS OF MICROMETERS)

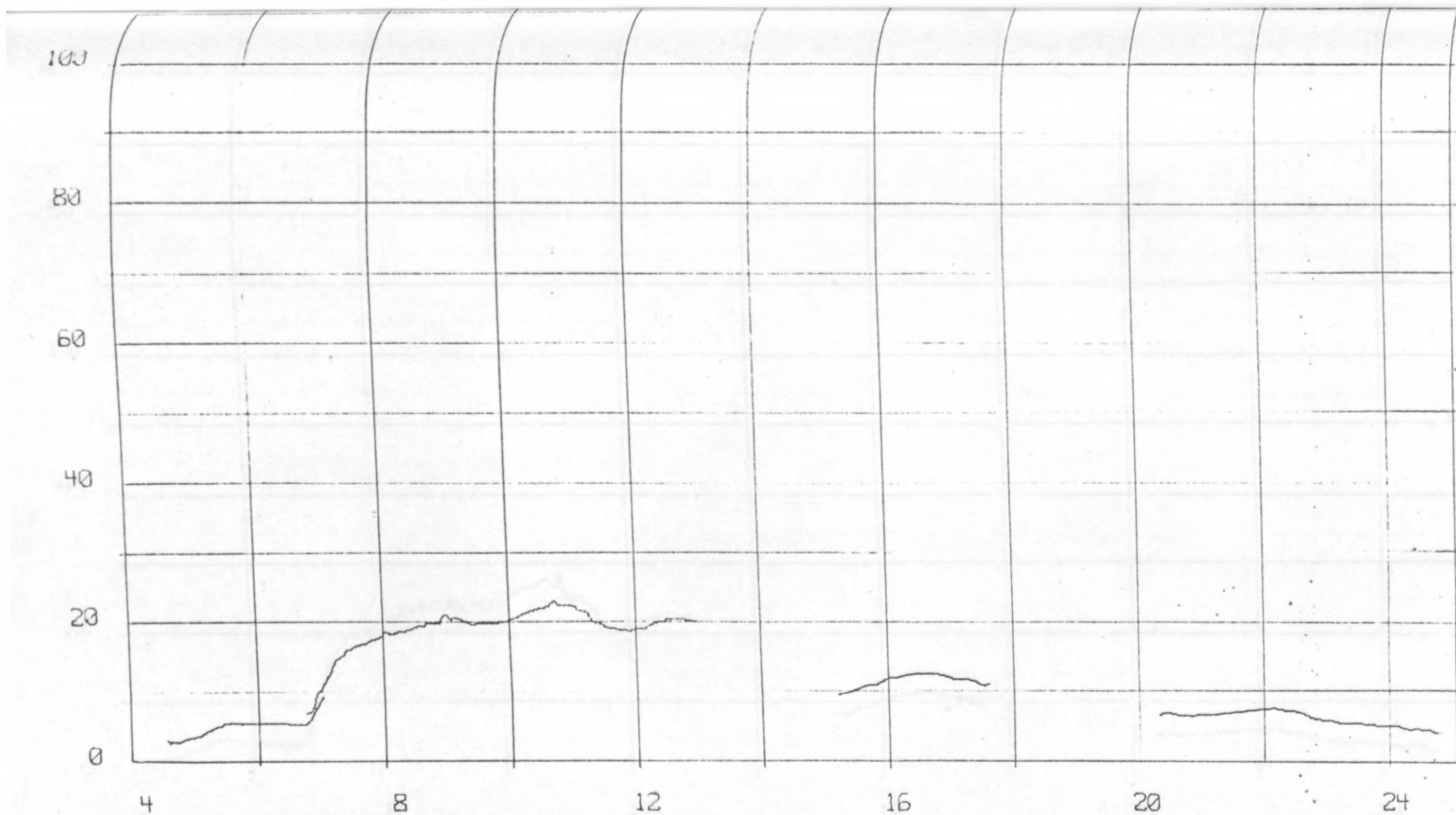
9 AUG 77

9
INTIC, UTAH, TAPE (10) SITE: H-103/MORMON TEA

305/307

ABSOLUTE REFLECTANCE

Fig. 66 Ephedra viridis



WAVELENGTH (TENTHS OF MICROMETERS)

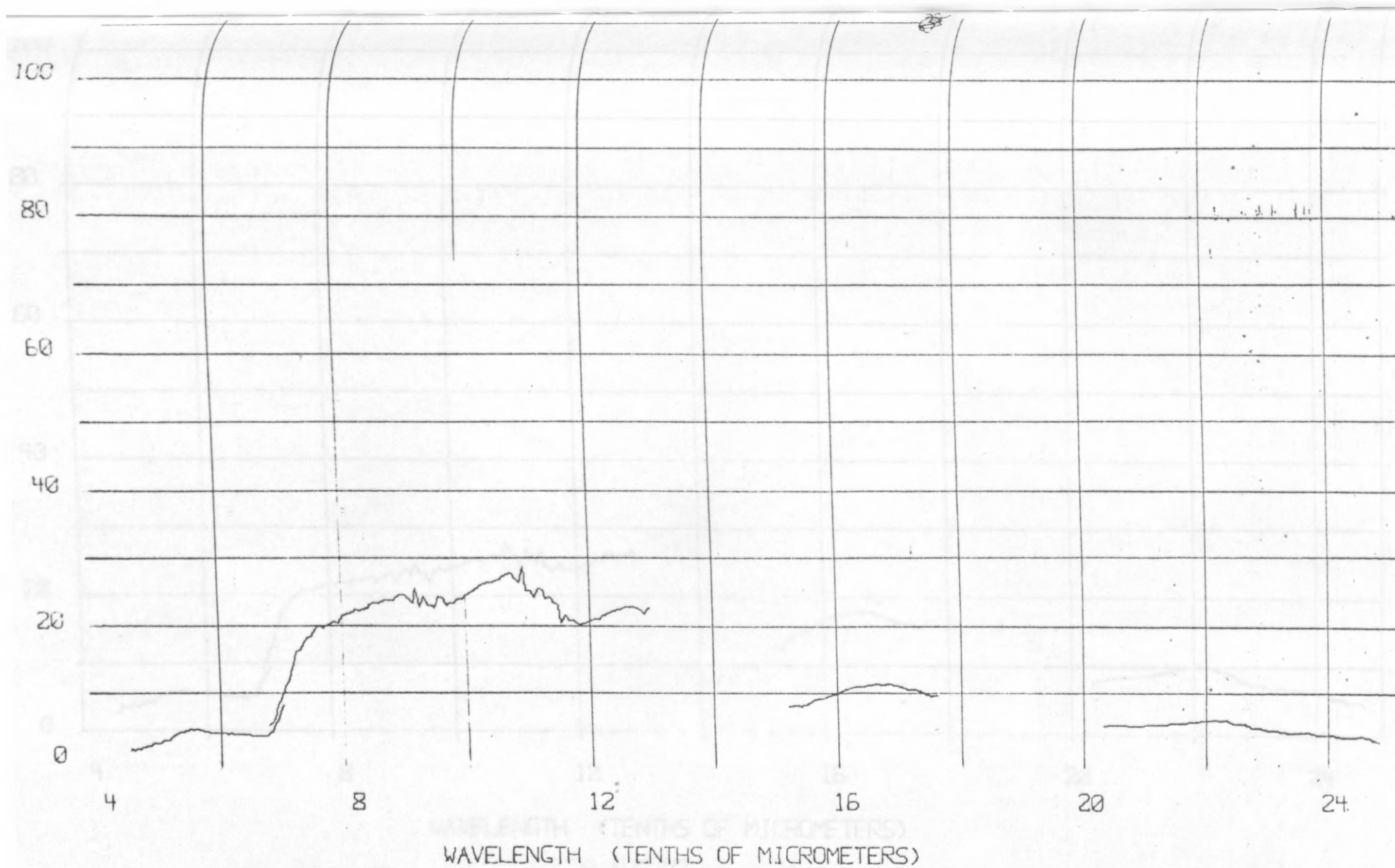
3 AUG 77

TINTIC, UTAH, TAPE (1) SITE: D-48/EPHEDRAVIRIDIS

154/155

ABSOLUTE REFLECTANCE

Fig. 67 *Ephedra viridis*



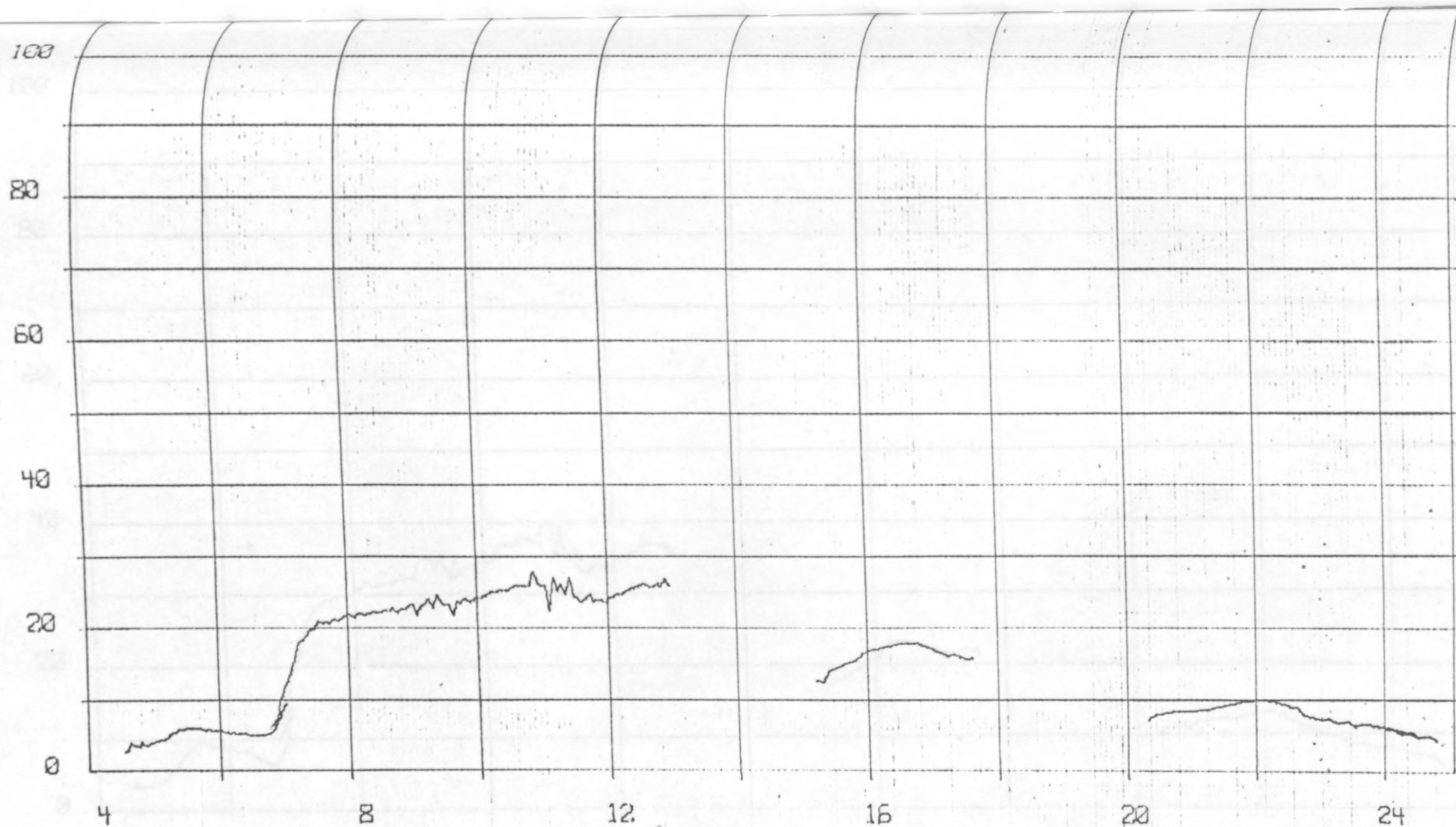
7 AUG 77

TINTIC, UTAH, TAPE (3B) SITE: A-13/LUSH MORMON TE

116/117

ABSOLUTE REFLECTANCE

Fig. 68 Ephedra viridis



WAVELENGTH (TENTHS OF MICROMETERS)

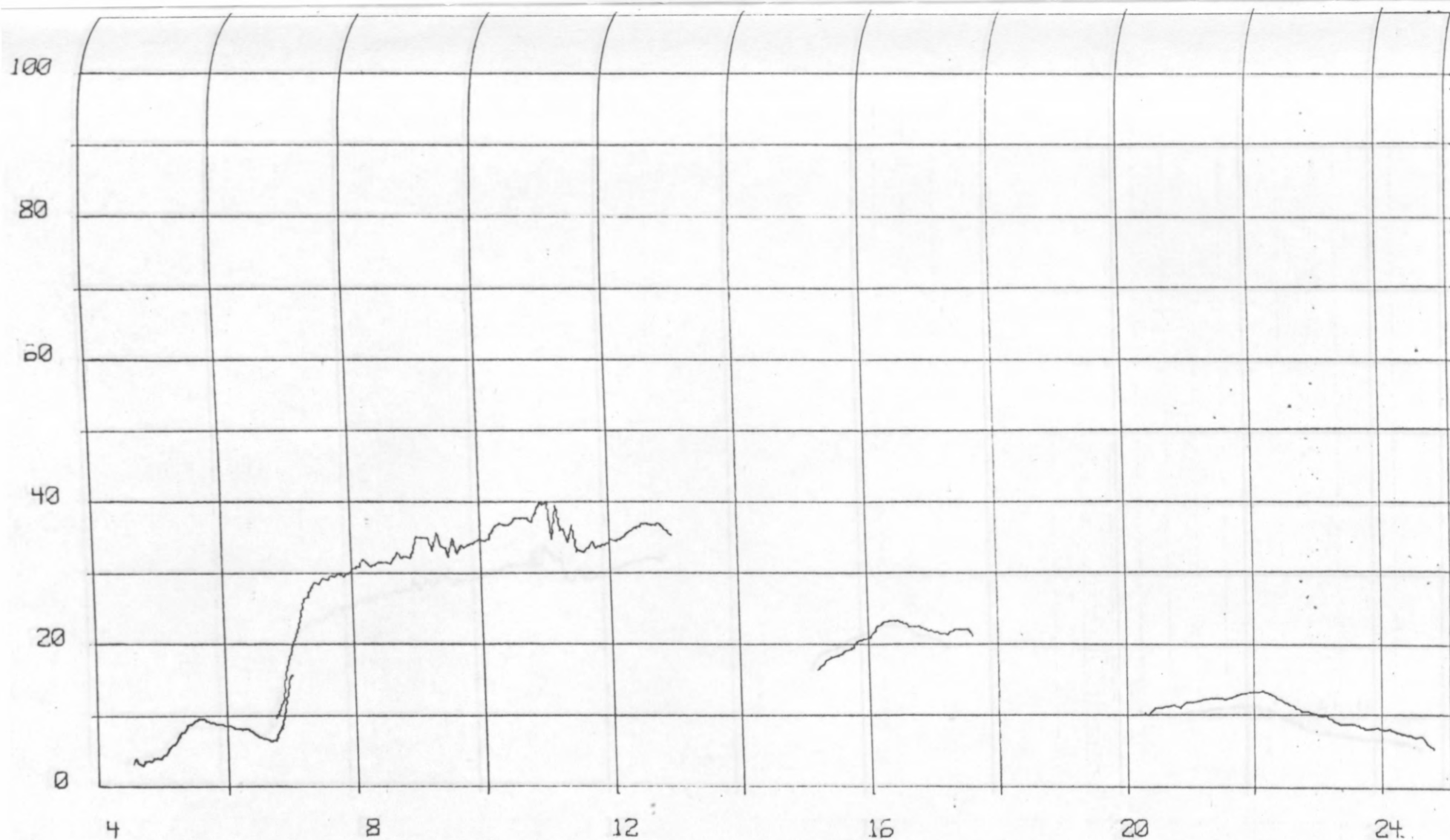
9 AUG 77

TINTIC, UTAH, TAPE ⁹(10) SITE: H-104/RABBIT BRUSH

311/313

ABSOLUTE REFLECTANCE

Fig. 69 Tetradymia glabrata



WAVELENGTH (TENTHS OF MICROMETERS)

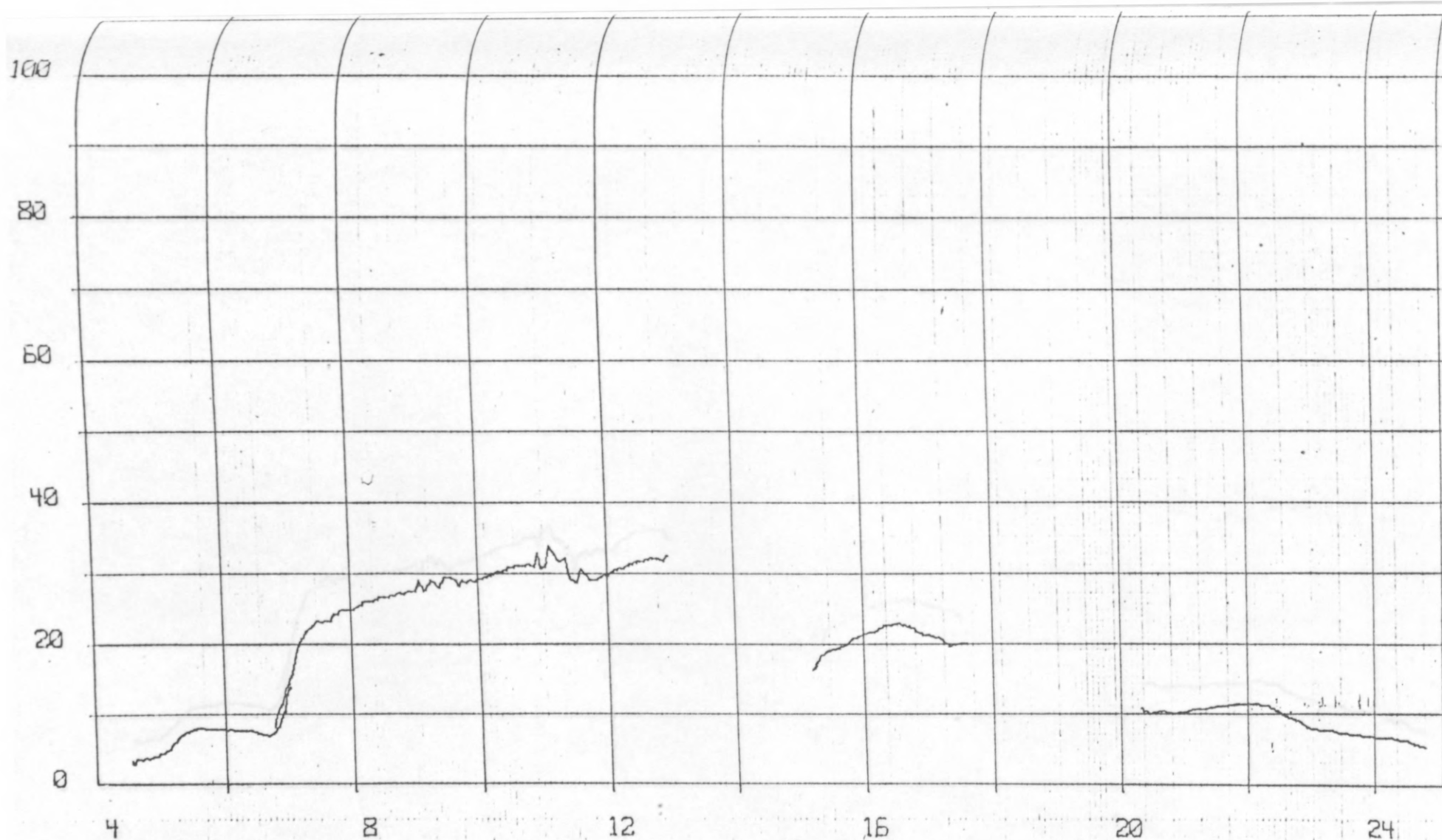
8 AUG 77

TINTIC, UTAH, TAPE (5B) SITE: A-10/SNAKE WEED

027/030

ABSOLUTE REFLECTANCE

Fig. 70 Gutierrezia sarathroe



WAVELENGTH (TENTHS OF MICROMETERS)

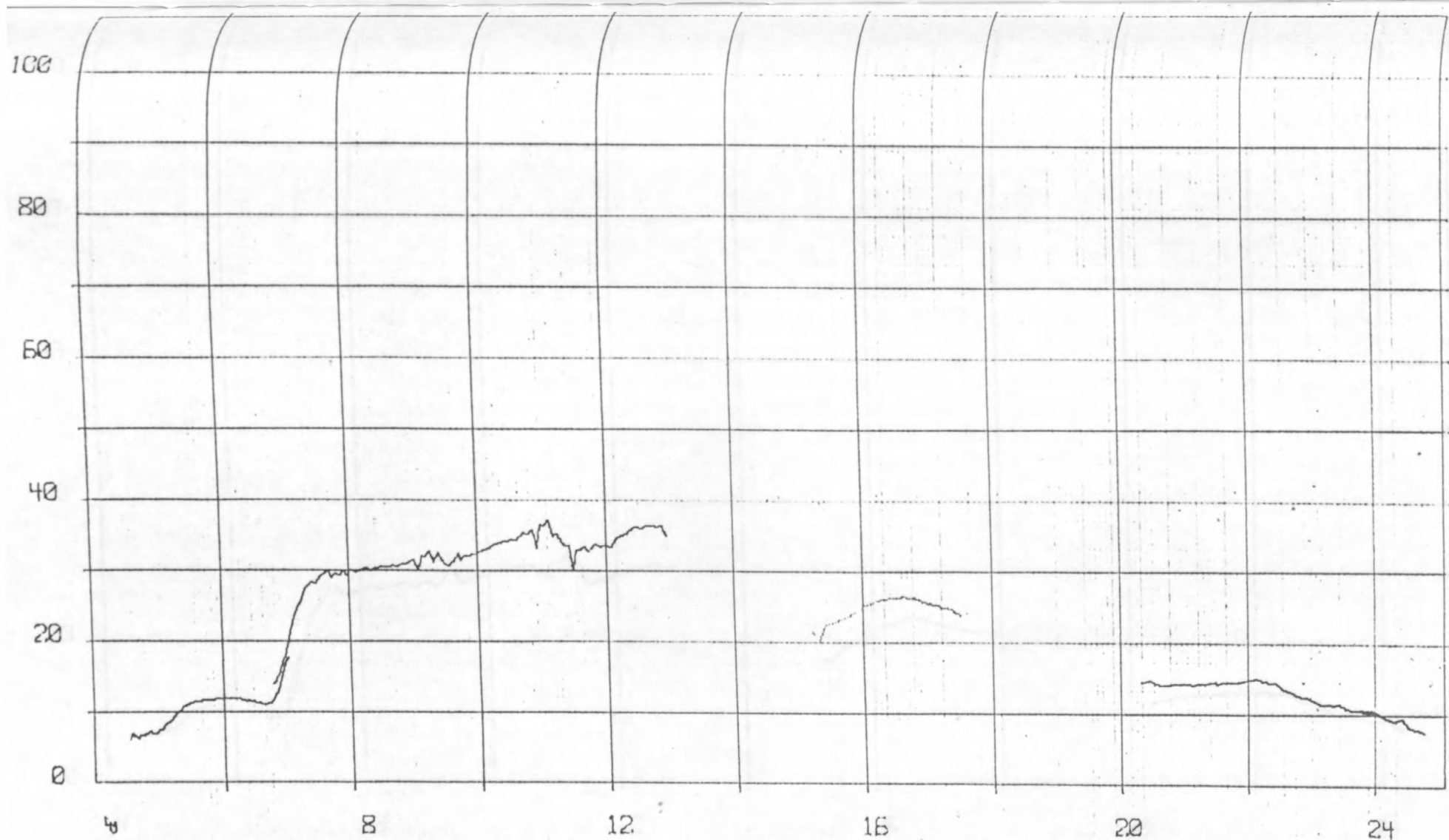
9 AUG 77

TINTIC, UTAH. TAPE ⁹(10) SITE: G-86/SNAKEWEED

201/203

ABSOLUTE REFLECTANCE

Fig. 71 Gutierrezia sarathroe



WAVELENGTH (TENTHS OF MICROMETERS)

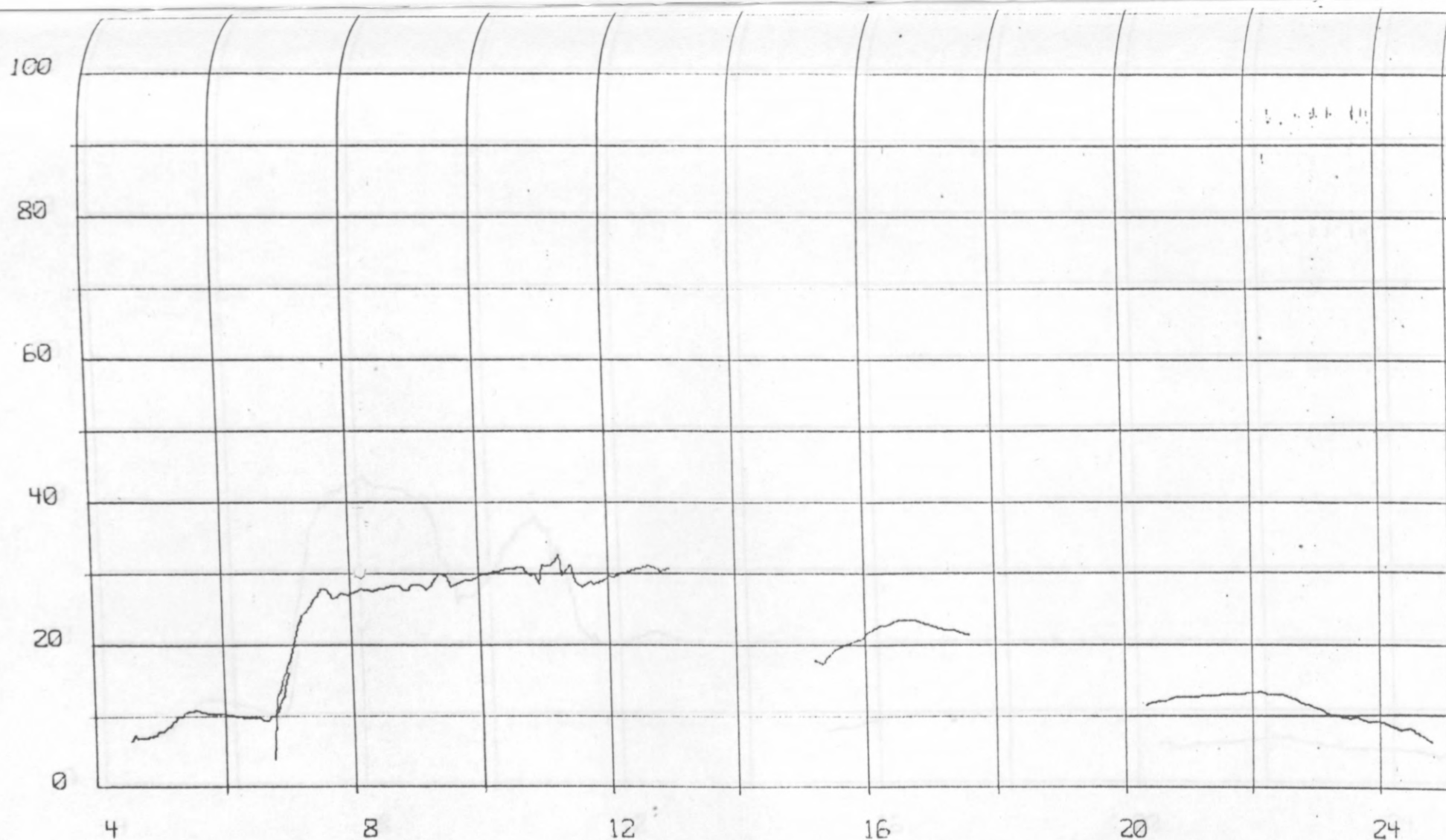
8 AUG 77

TINTIC, UTAH, TAPE (7) SITE: F-100/YEL FLWR HERB

153/155

ABSOLUTE REFLECTANCE

Fig. 72 Petradora pumila



WAVELENGTH (TENTHS OF MICROMETERS)

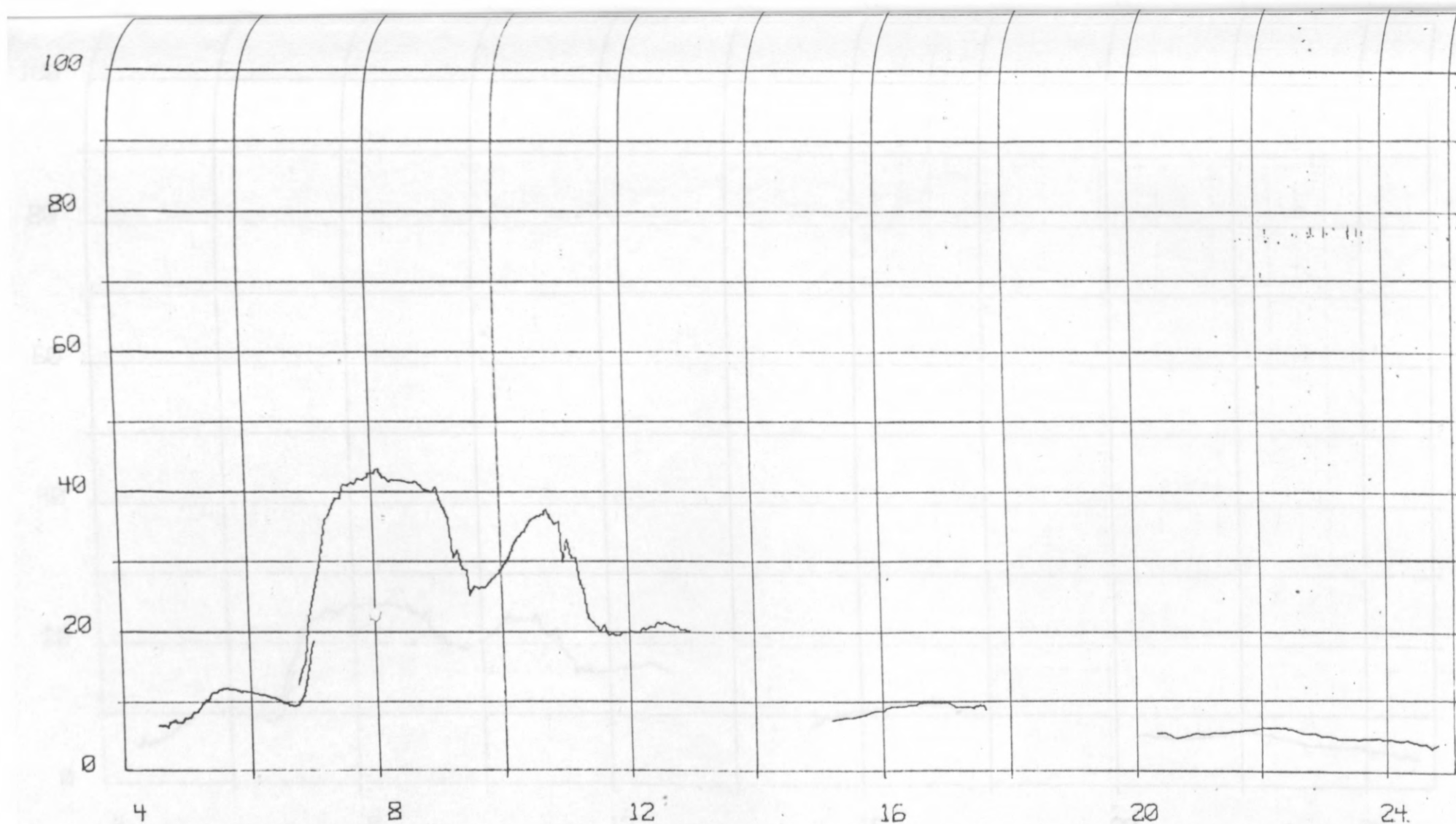
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: B-32/TUFT-ASK NANCY

031/033

ABSOLUTE REFLECTANCE

Fig. 73 Haplopappus acaulis



WAVELENGTH (TENTHS OF MICROMETERS)

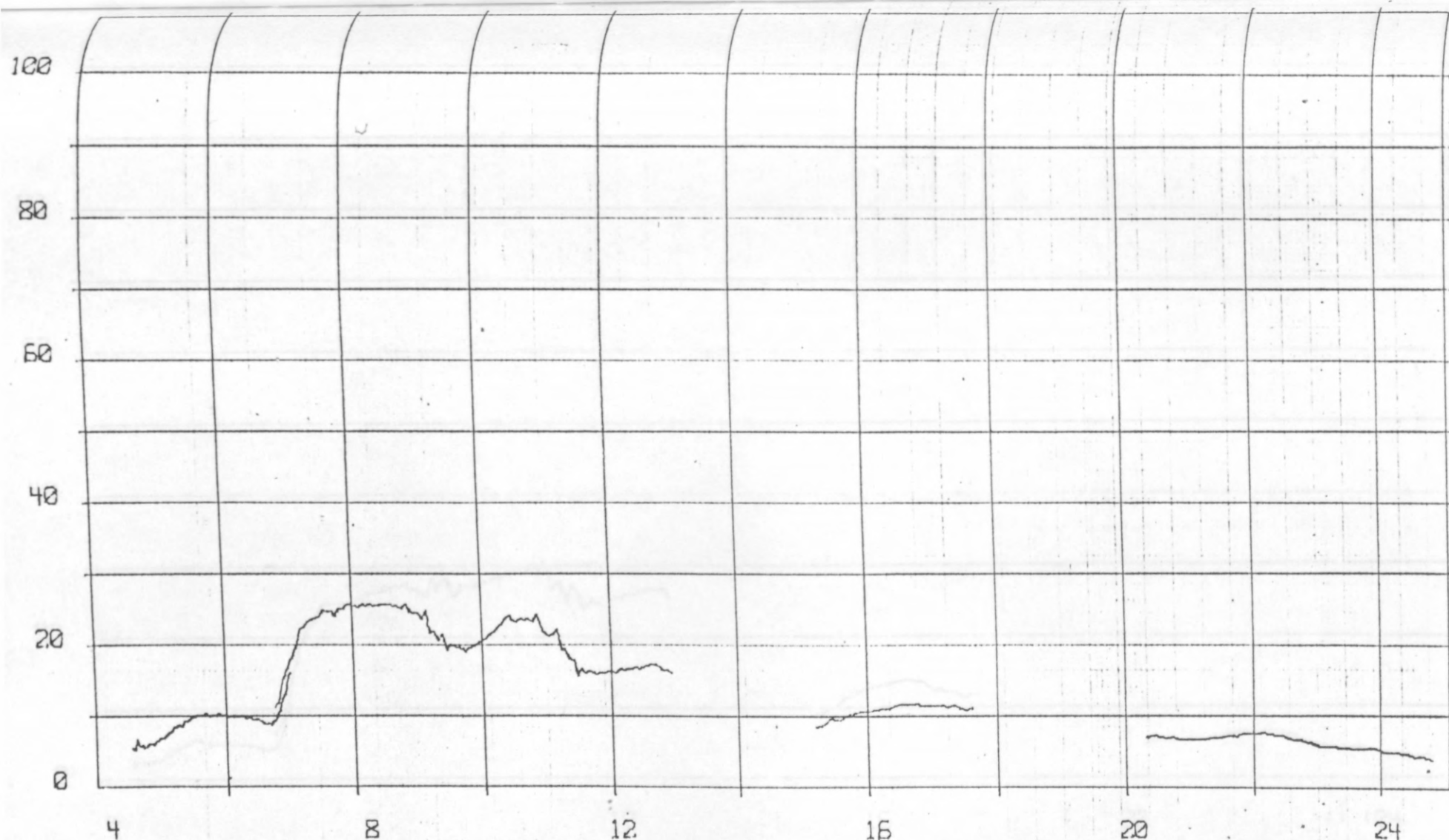
8 AUG 77

TINTIC, UTAH, TAPE (5B) SITE: A-7/PRICKLY PEAR

021/022

ABSOLUTE REFLECTANCE

Fig. 74 Opuntia



WAVELENGTH (TENTHS OF MICROMETERS)

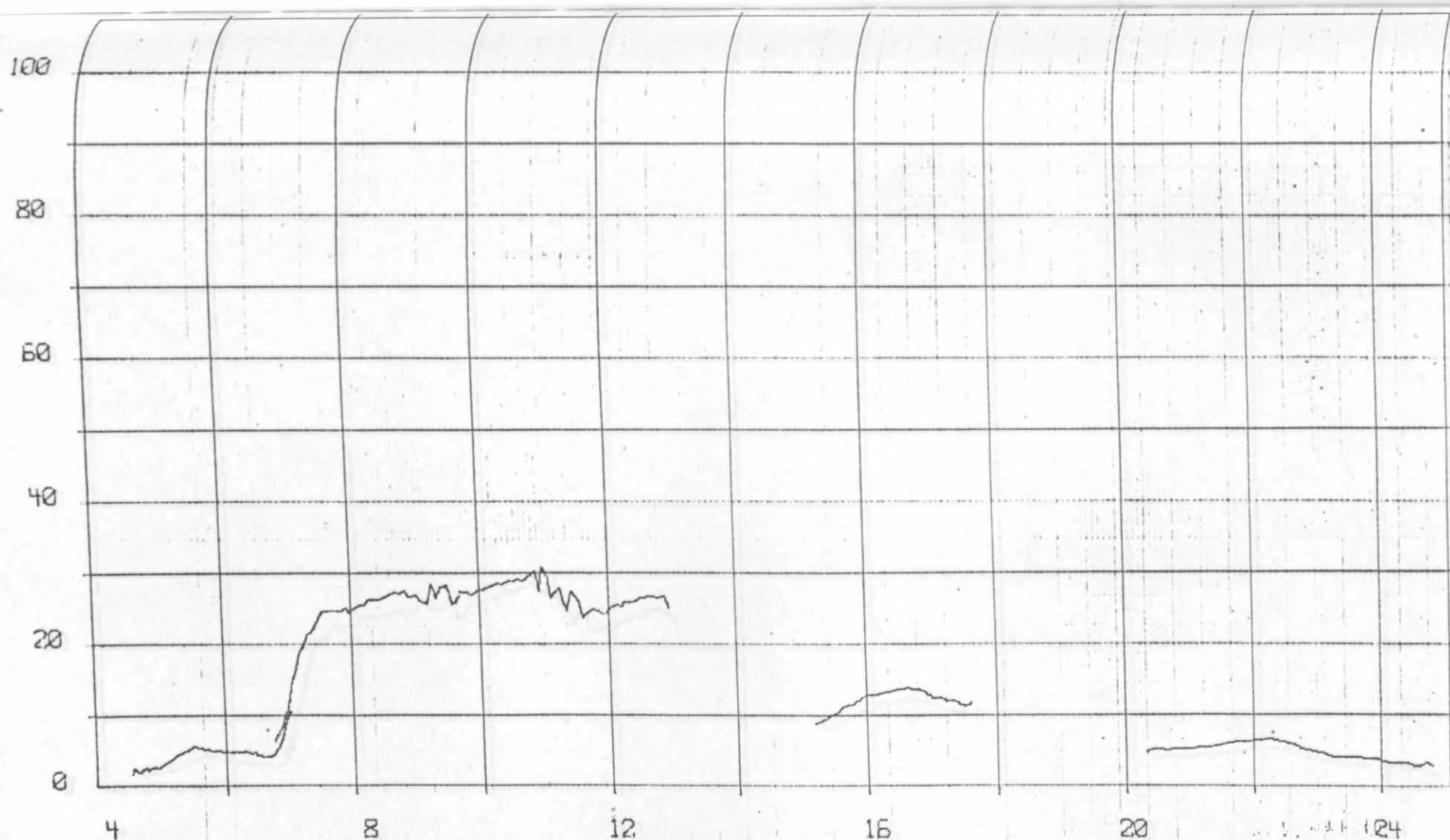
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: A-14/PRICKLY PEAR

063/065

ABSOLUTE REFLECTANCE

Fig. 75 Opuntia



WAVELENGTH (TENTHS OF MICROMETERS)

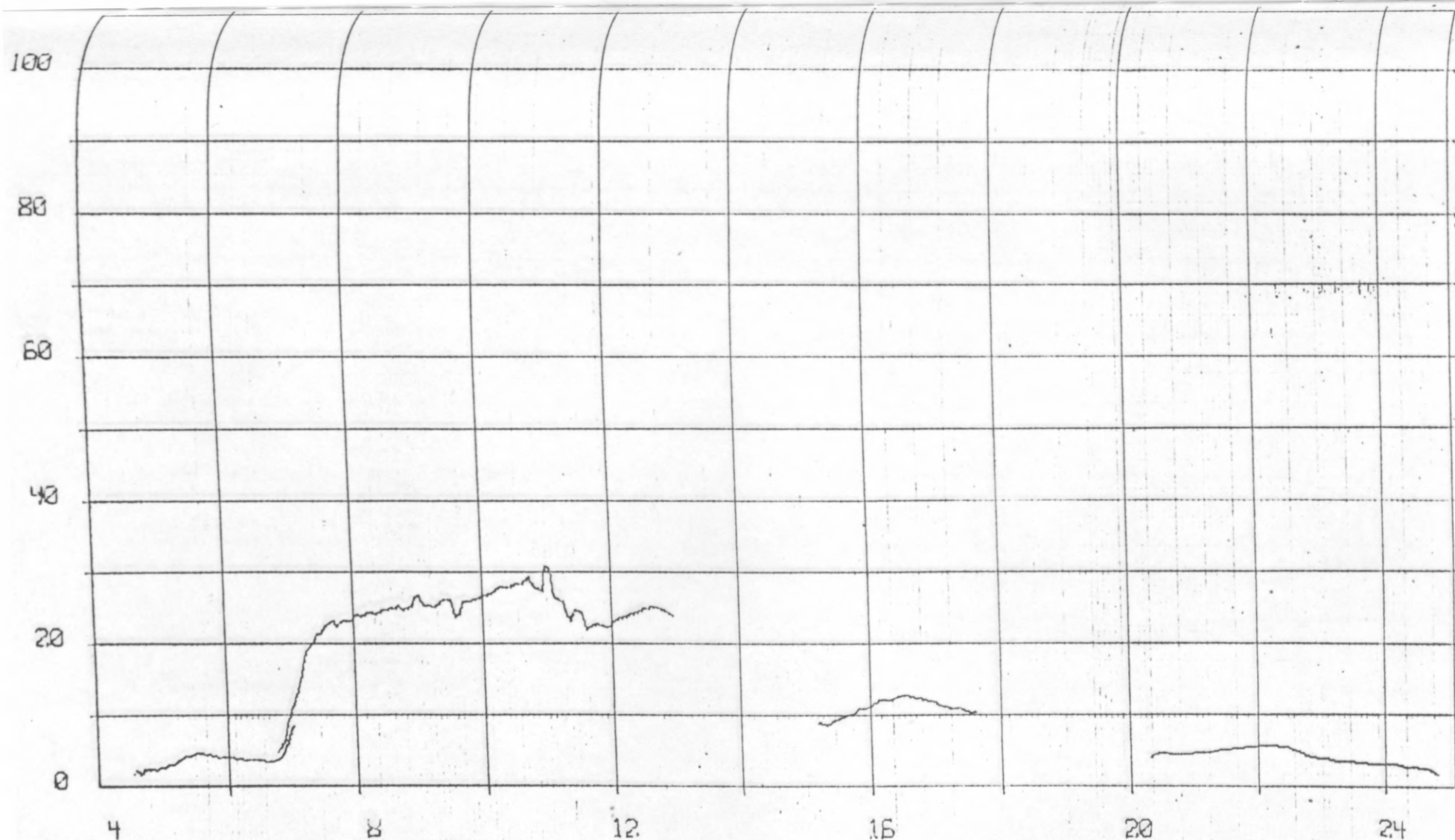
10 AUG '77

TINTIC, UTAH, TAPE (10) SITE: A-14B/A14 VERTICAL

113/115

ABSOLUTE REFLECTANCE

Fig. 76 Cowania mexicana



WAVELENGTH (TENTHS OF MICROMETERS)

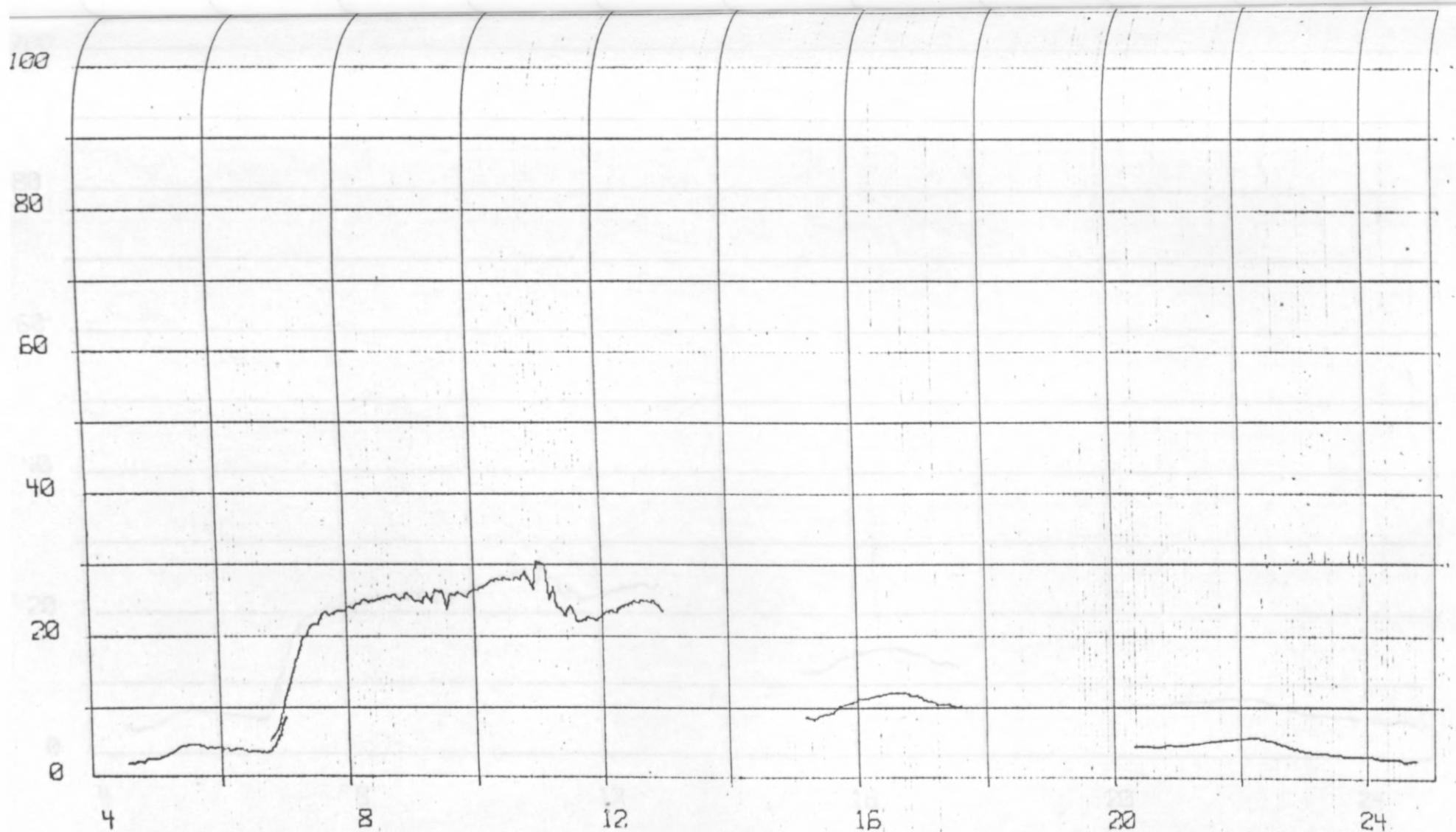
10 AUG 77

TINTIC, UTAH, TAPE (10) SITE: A-14/CLIFF ROSE(OV)

001/103

ABSOLUTE REFLECTANCE

Fig. 77 Cowania mexicana



WAVELENGTH (TENTHS OF MICROMETERS)

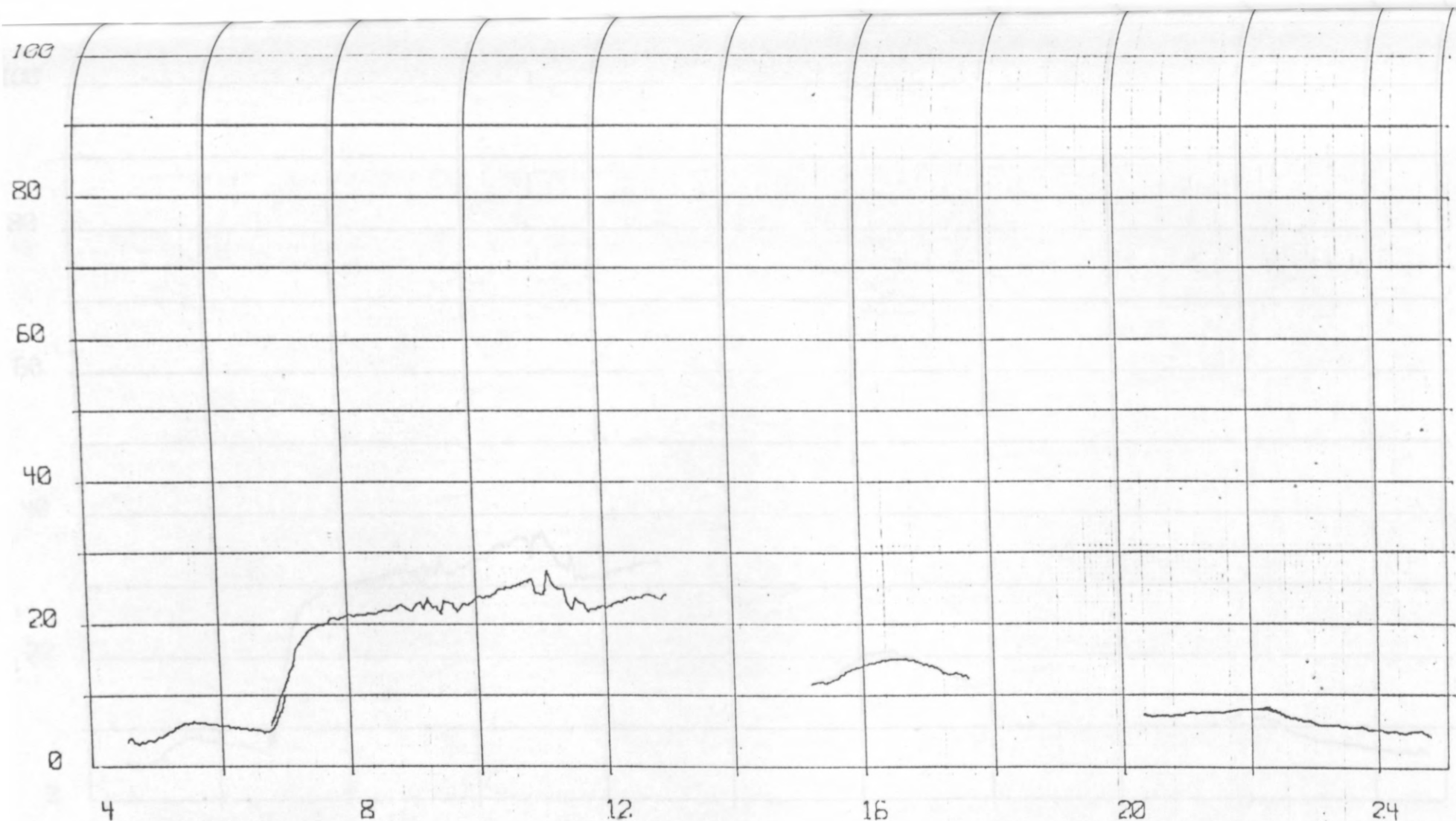
10 AUG 77

INTIC, UTAH. TAPE (10) SITE: A-14A/A14 OBLIQUER

105/107

ABSOLUTE REFLECTANCE

Fig. 78 Cowania mexicana



WAVELENGTH: (TENTHS OF MICROMETERS)

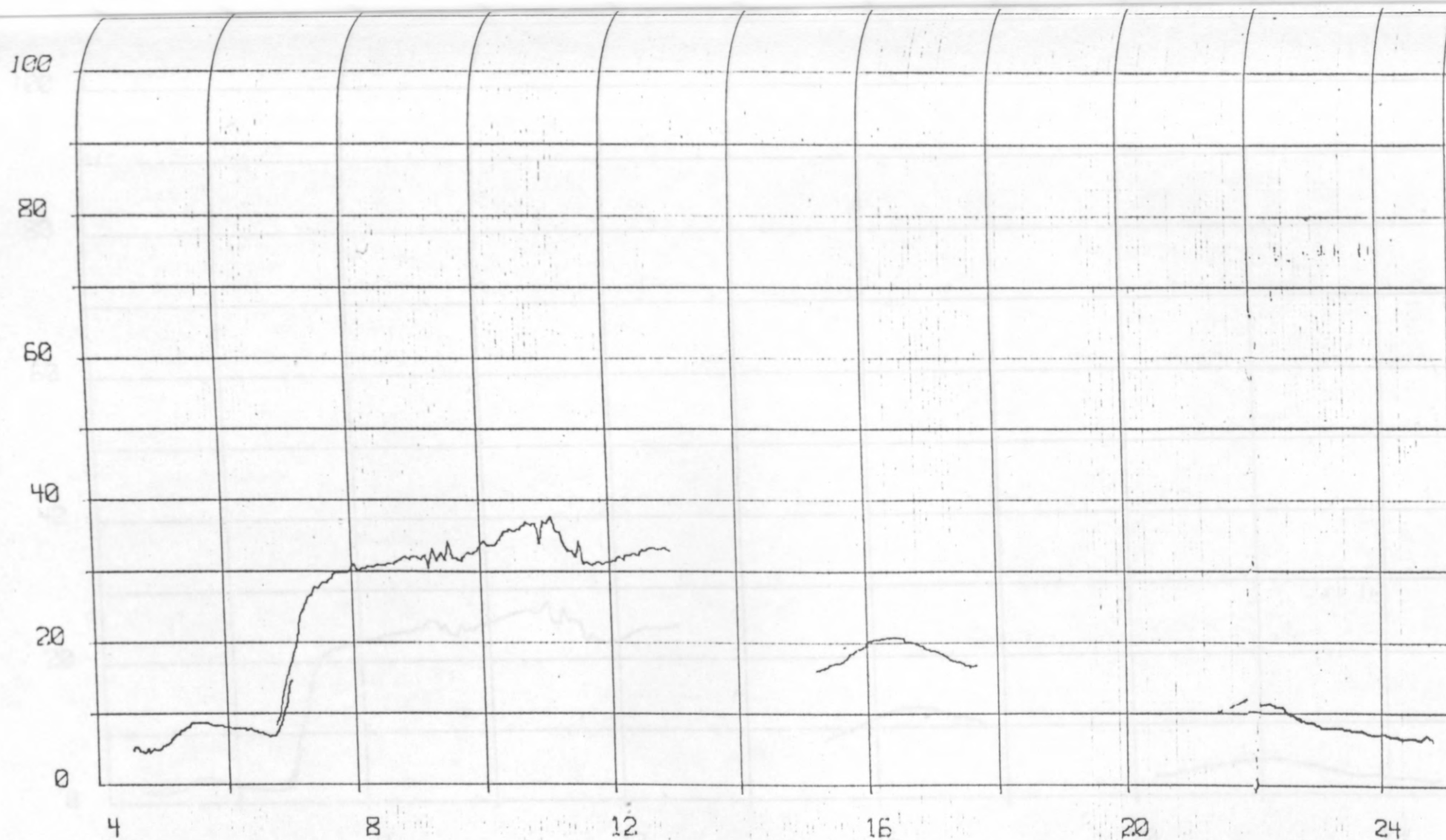
8 AUG '77

TINTIC, UTAH, TAPE (7) SITE: F-103/CLIFF ROSE

167/171

ABSOLUTE REFLECTANCE

Fig. 79 Cowania mexicana



WAVELENGTH (TENTHS OF MICROMETERS)

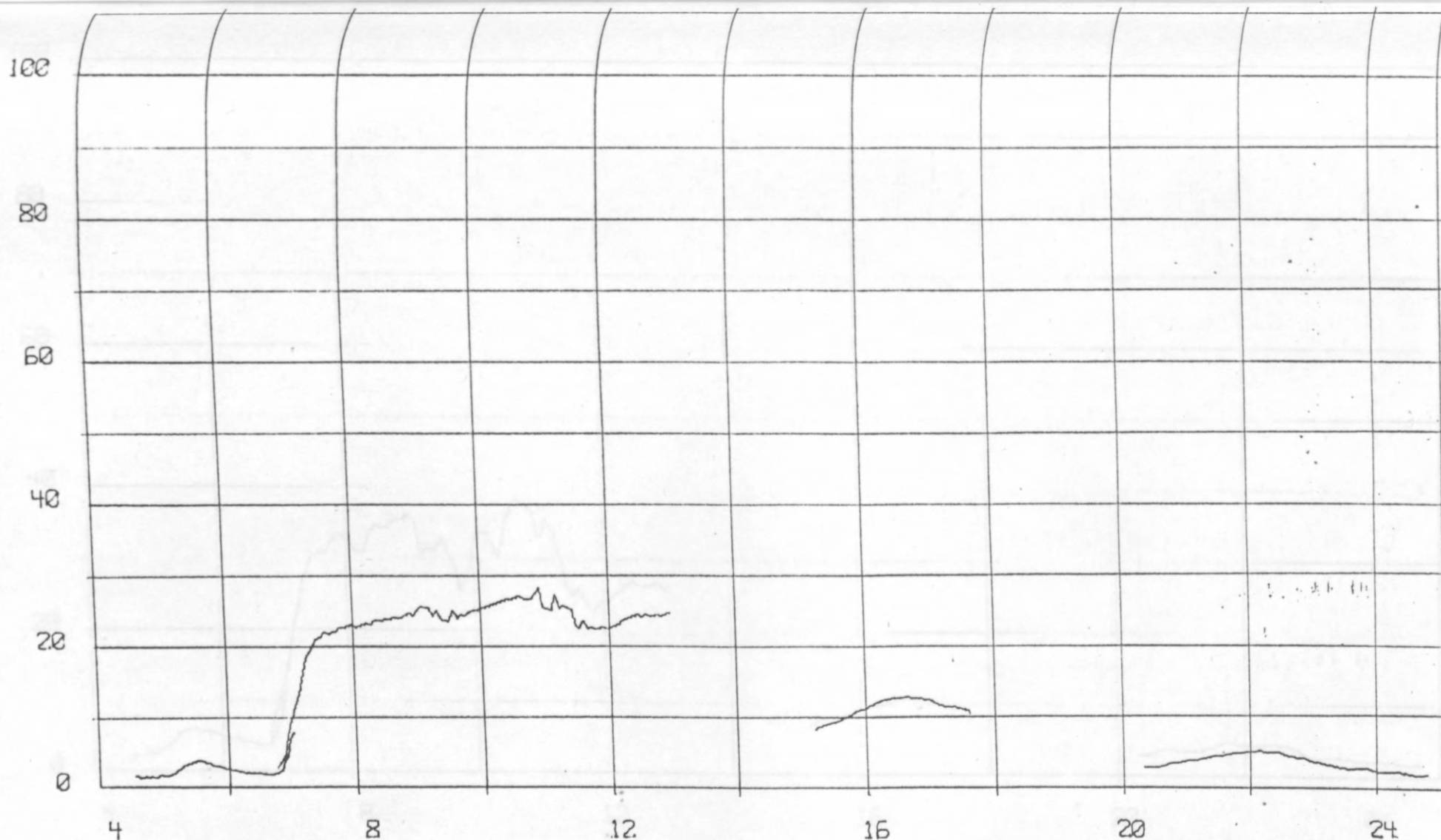
8 AUG 77

TINTIC, UTAH, TAPE (7) SITE: F-103/CLIFF ROSE

167/173

ABSOLUTE REFLECTANCE

Fig. 80 Cowania mexicana



WAVELENGTH (TENTHS OF MICROMETERS)

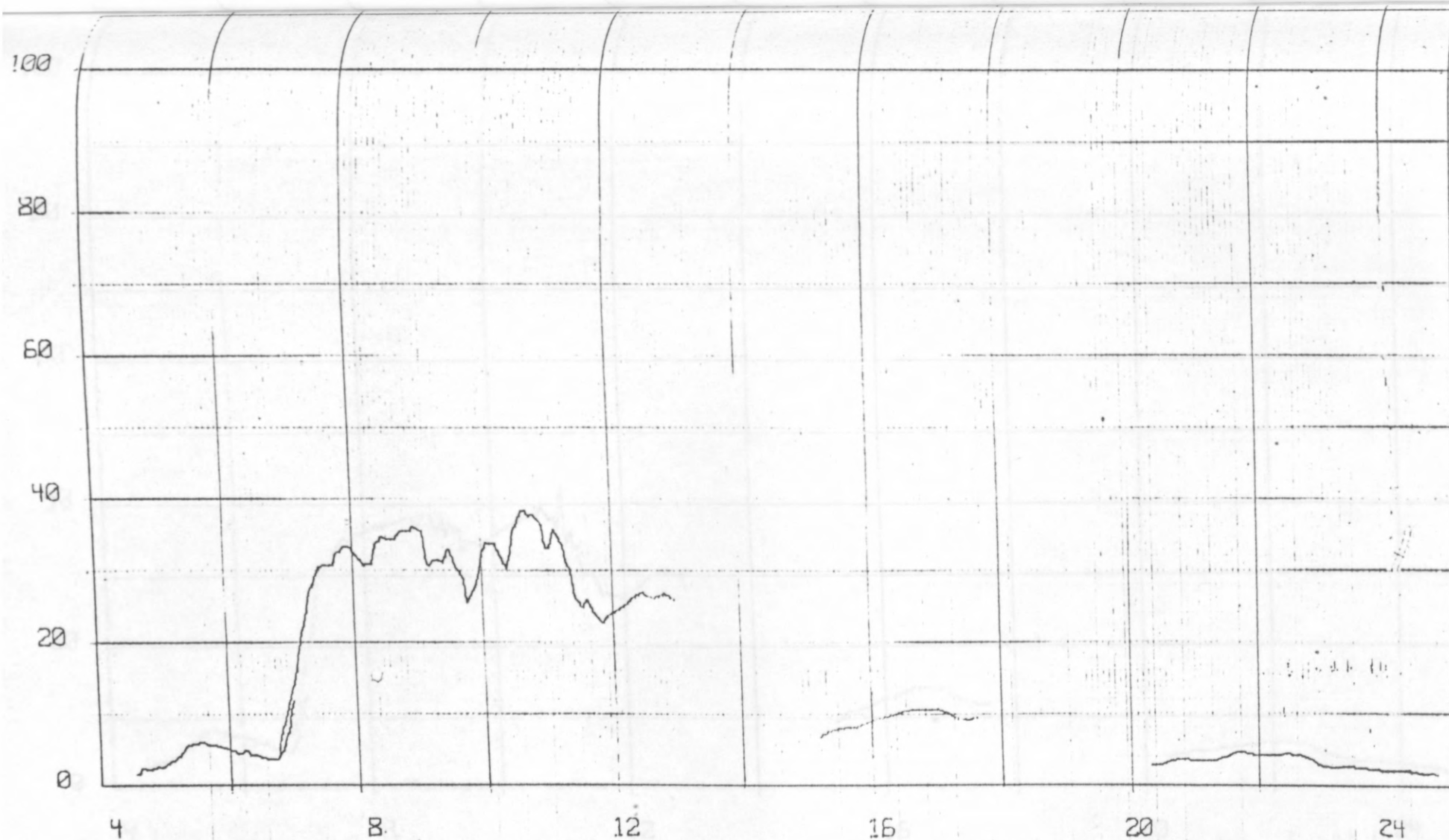
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: B-43/MT MAHOGANY

105/107

ABSOLUTE REFLECTANCE

Fig. 81 Cercocarpus montanus



WAVELENGTH (TENTHS OF MICROMETERS)

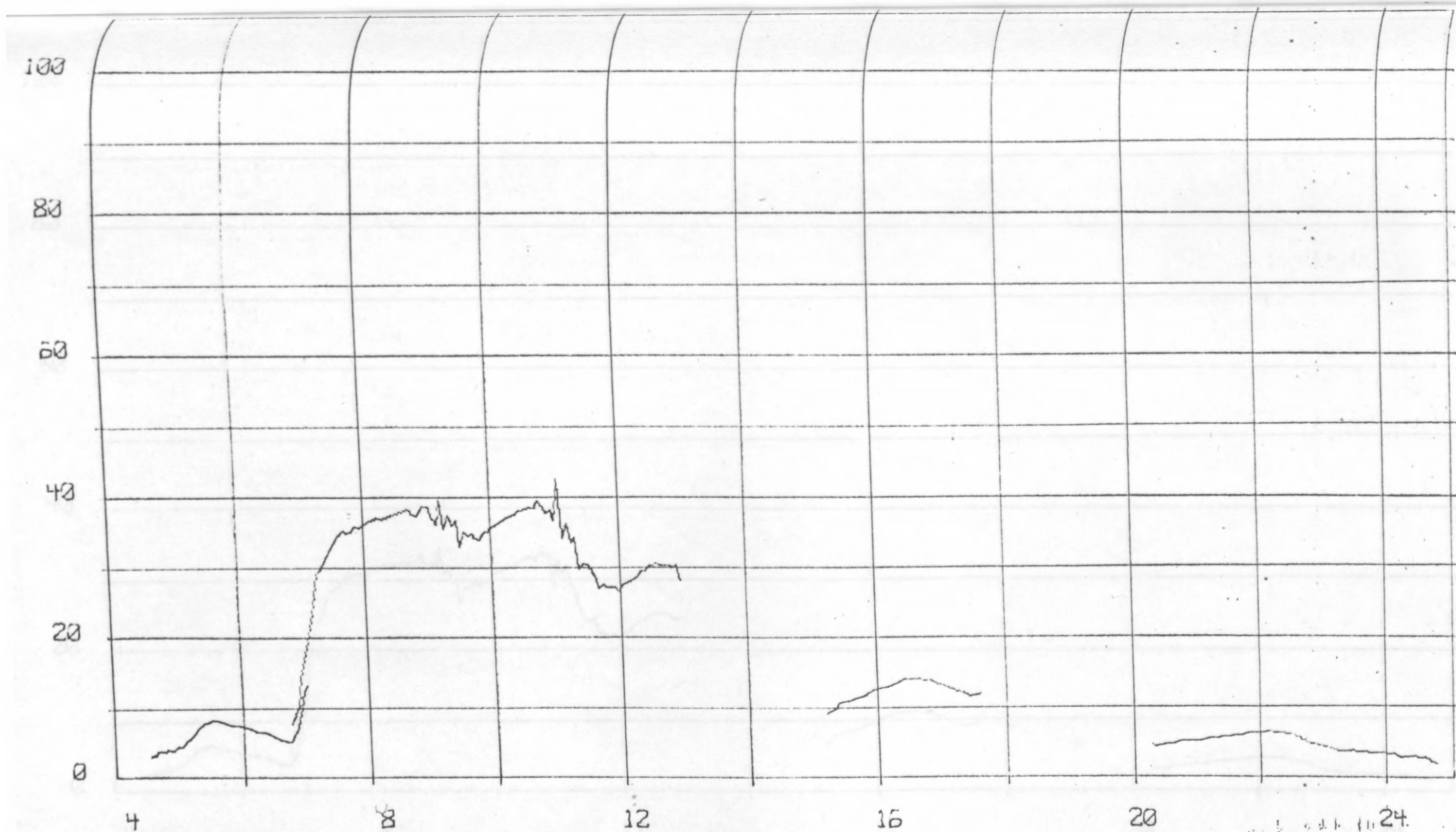
9 AUG 77

TINTIC, UTAH. TAPE ⁹~~10~~ SITE: D-54/JUNIPER

001/003

ABSOLUTE REFLECTANCE

Fig. 82 Juniperus osteosperma



WAVELENGTH (TENTHS OF MICROMETERS)

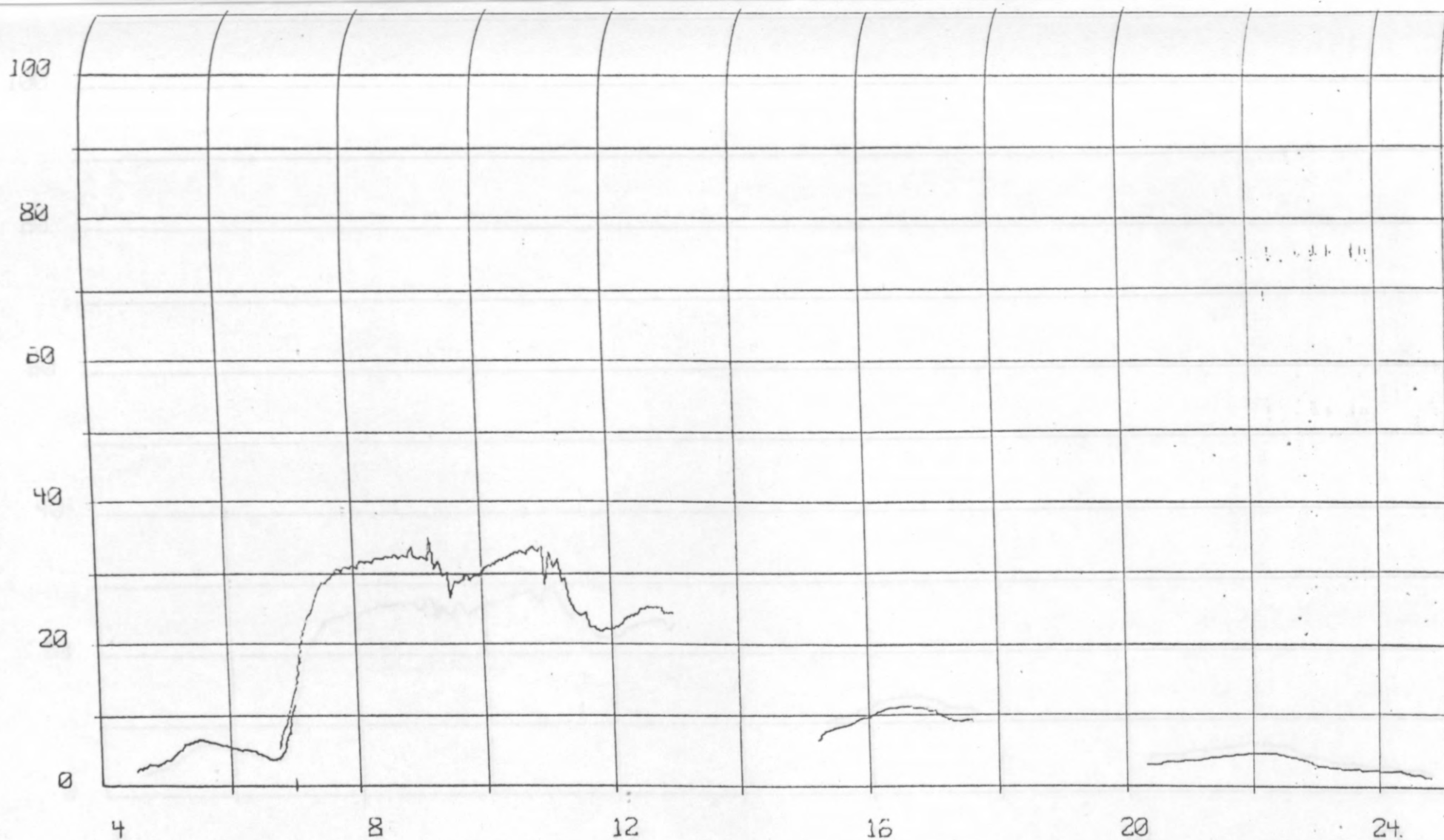
5 AUG 77

TINTIC, UTAH, TAPE (2) SITE: C-24/JUNIPER W/HB

106/107

ABSOLUTE REFLECTANCE

Fig. 83 Juniperus osteosperma



WAVELENGTH (TENTHS OF MICROMETERS)

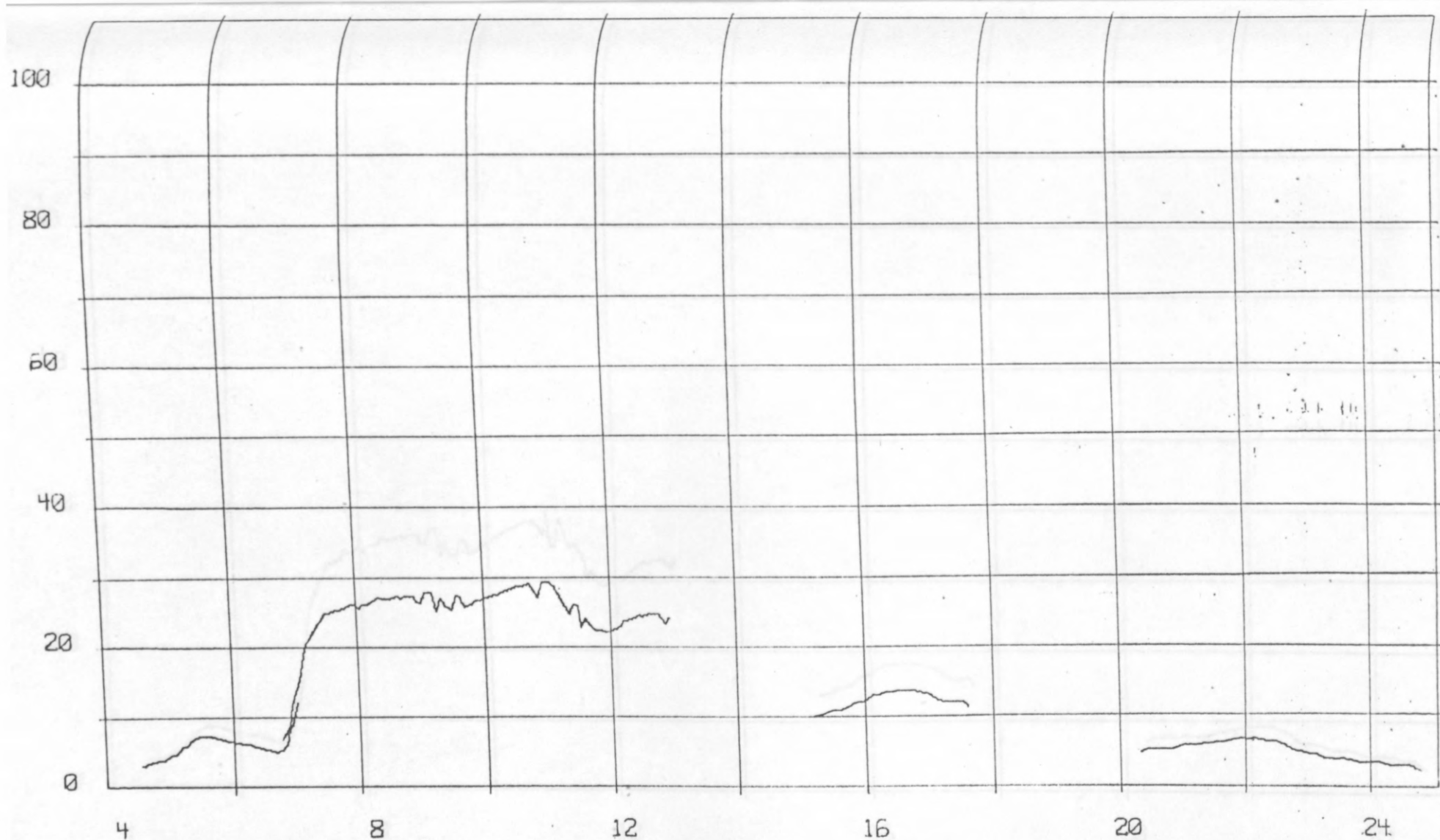
5 AUG 77

TINTIC, UTAH, TAPE (2) SITE: C-24/JUNIPER W/OHB

110/107

ABSOLUTE REFLECTANCE

Fig. 84 Juniperus osteosperma



WAVELENGTH (TENTHS OF MICROMETERS)

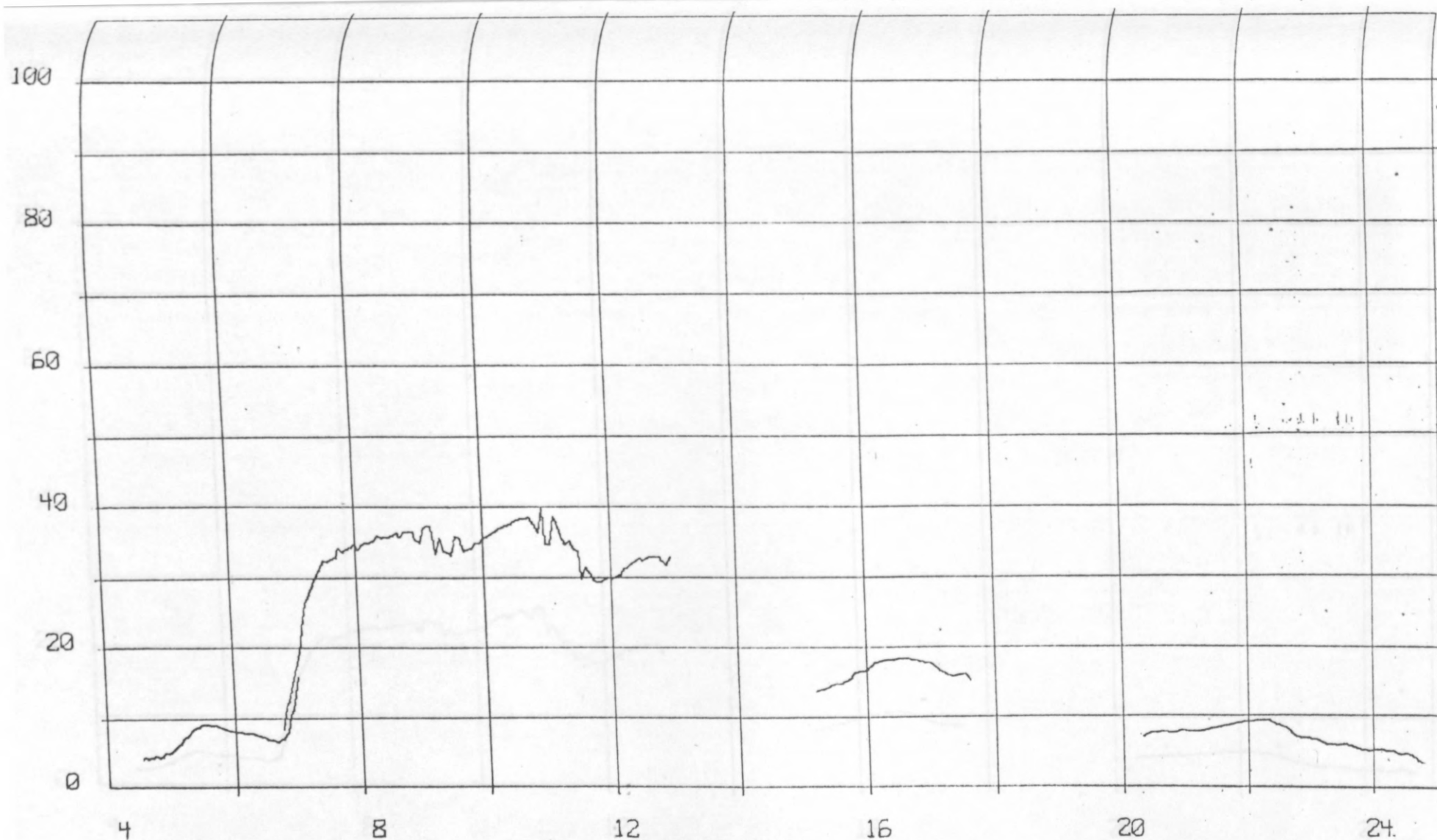
5 AUG 77

TINTIC, UTAH, TAPE (3) SITE: D-41/JUNIPER BRANCH

170/171

ABSOLUTE REFLECTANCE

Fig. 85 Juniperus osteosperma



WAVELENGTH (TENTHS OF MICROMETERS)

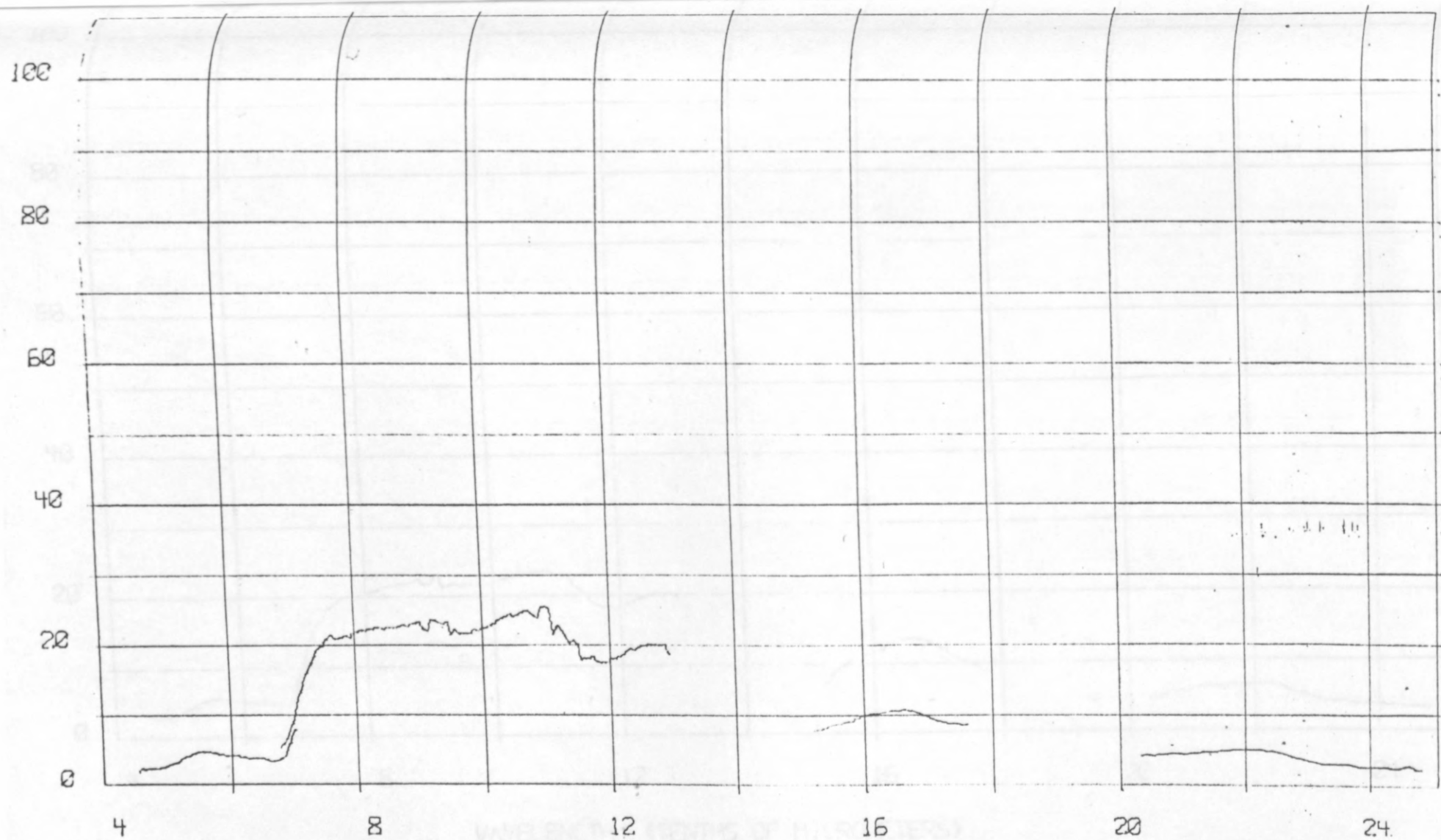
5 AUG 77

TINTIC, UTAH, TAPE (3) SITE: D-41/SOT W/OHB

172/171

ABSOLUTE REFLECTANCE

Fig. 86 Juniperus osteosperma



WAVELENGTH (TENTHS OF MICROMETERS)

S.W. N. Standard

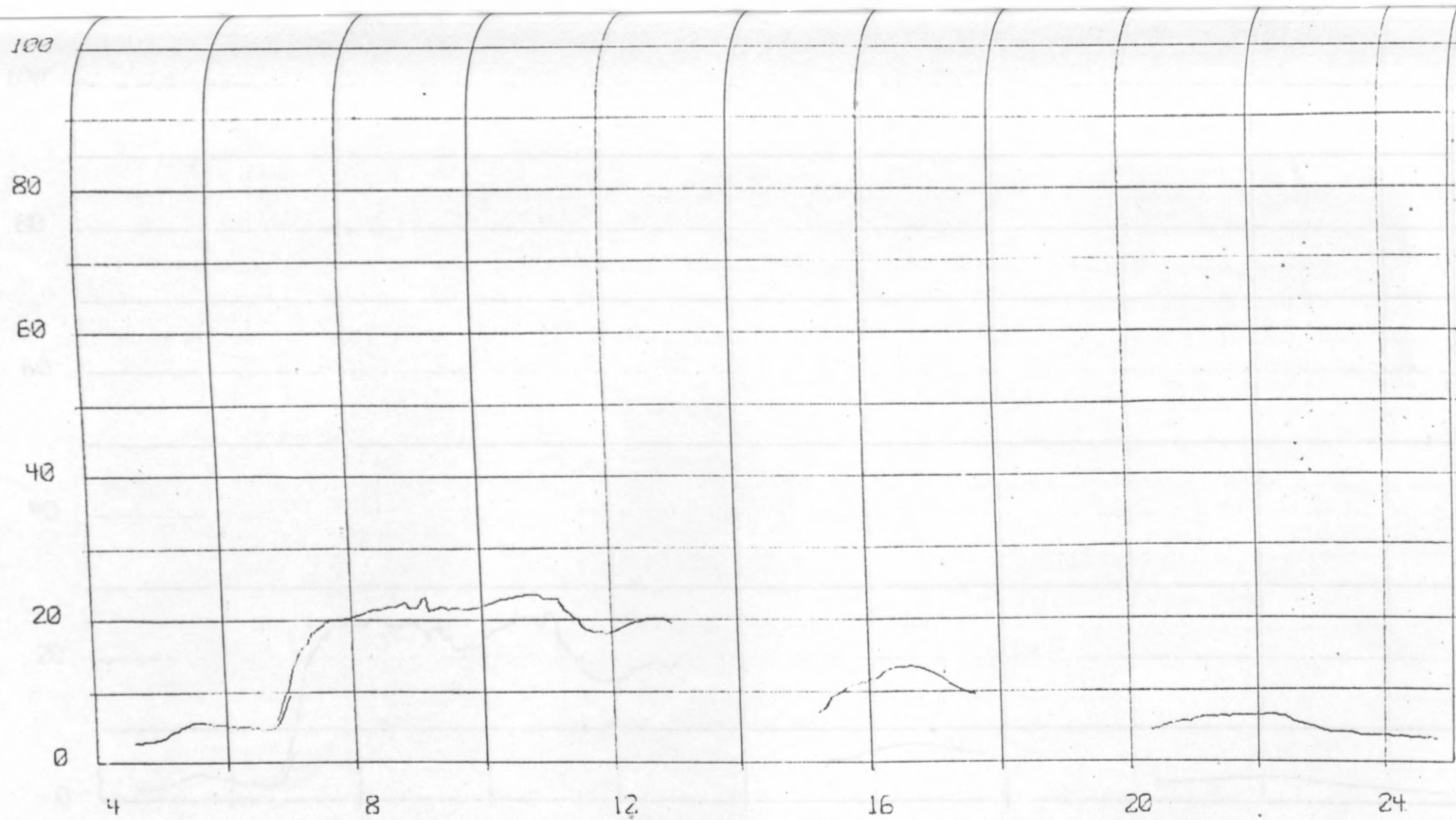
8 AUG 77

TINTIC, UTAH, TAPE (7) SITE: E-77/JUNIPER

001/003

ABSOLUTE REFLECTANCE

Fig. 87 Juniperus osteosperma



WAVELENGTH: (TENTHS OF MICROMETERS)

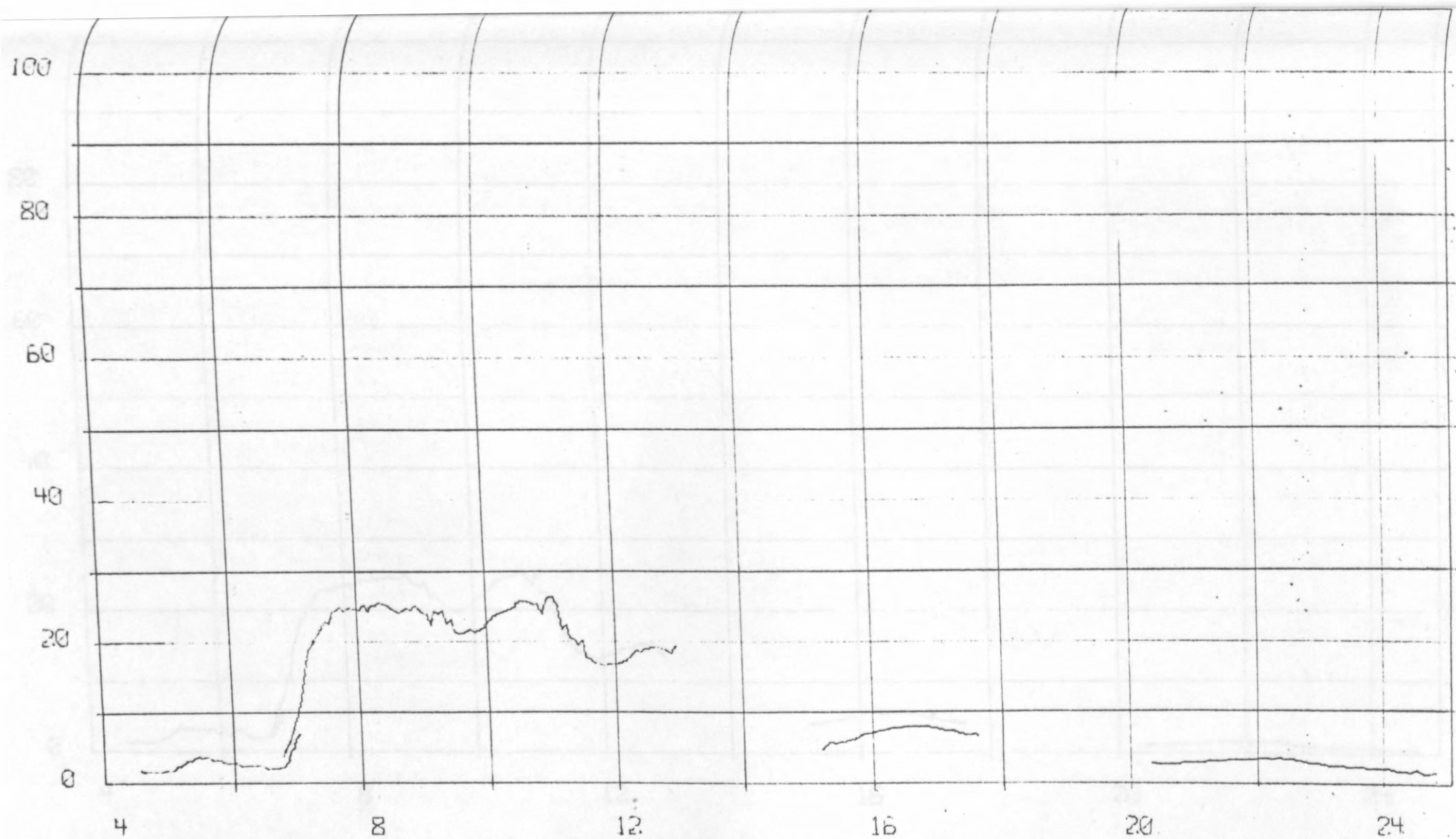
3 AUG 77

TINTIC, UTAH, TAPE (1) SITE: D-35/JUNIPER

120/122

ABSOLUTE REFLECTANCE

Fig. 88 Juniperus osteosperma



WAVELENGTH (TENTHS OF MICROMETERS)

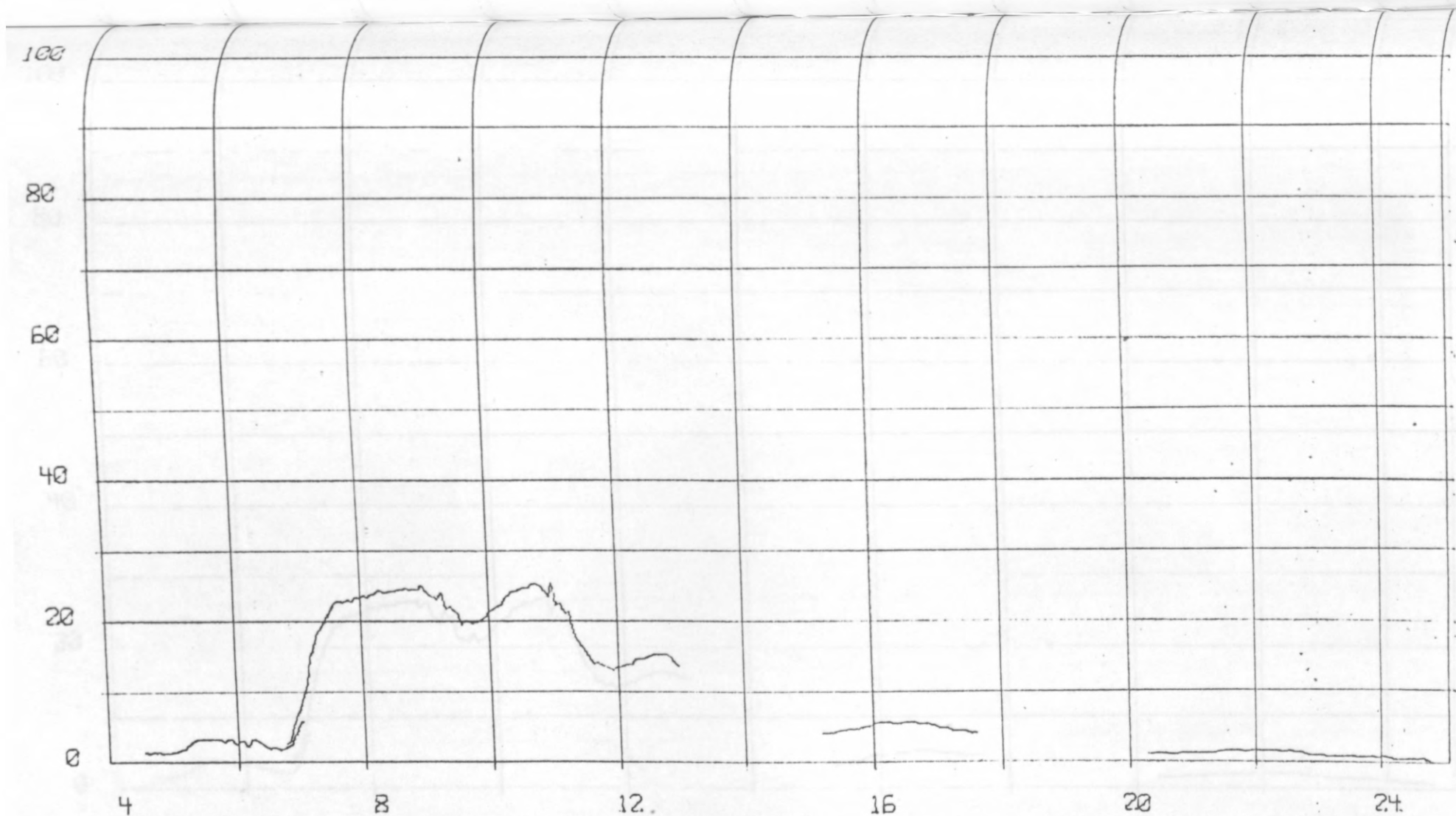
7 AUG 77

TINTIC, UTAH, TAPE (4) SITE: C-41/LG JUNIPER

215/216

ABSOLUTE REFLECTANCE

Fig. 89 Juniperus osteosperma



WAVELENGTH (TENTHS OF MICROMETERS)

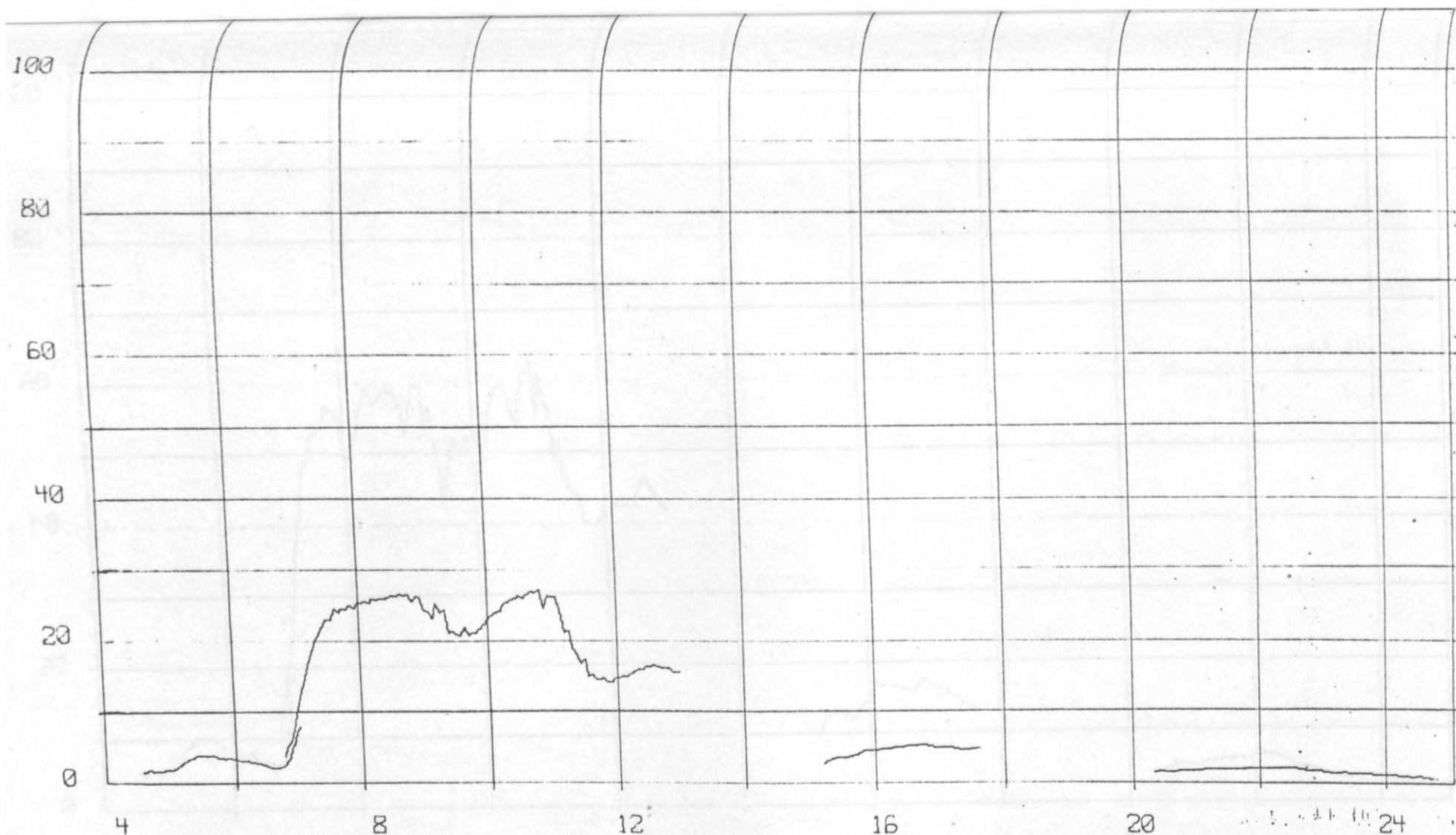
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: E-75/SNGL LEAF PINE

331/333

ABSOLUTE REFLECTANCE

Fig. 90 Pinus monophylla



WAVELENGTH (TENTHS OF MICROMETERS)

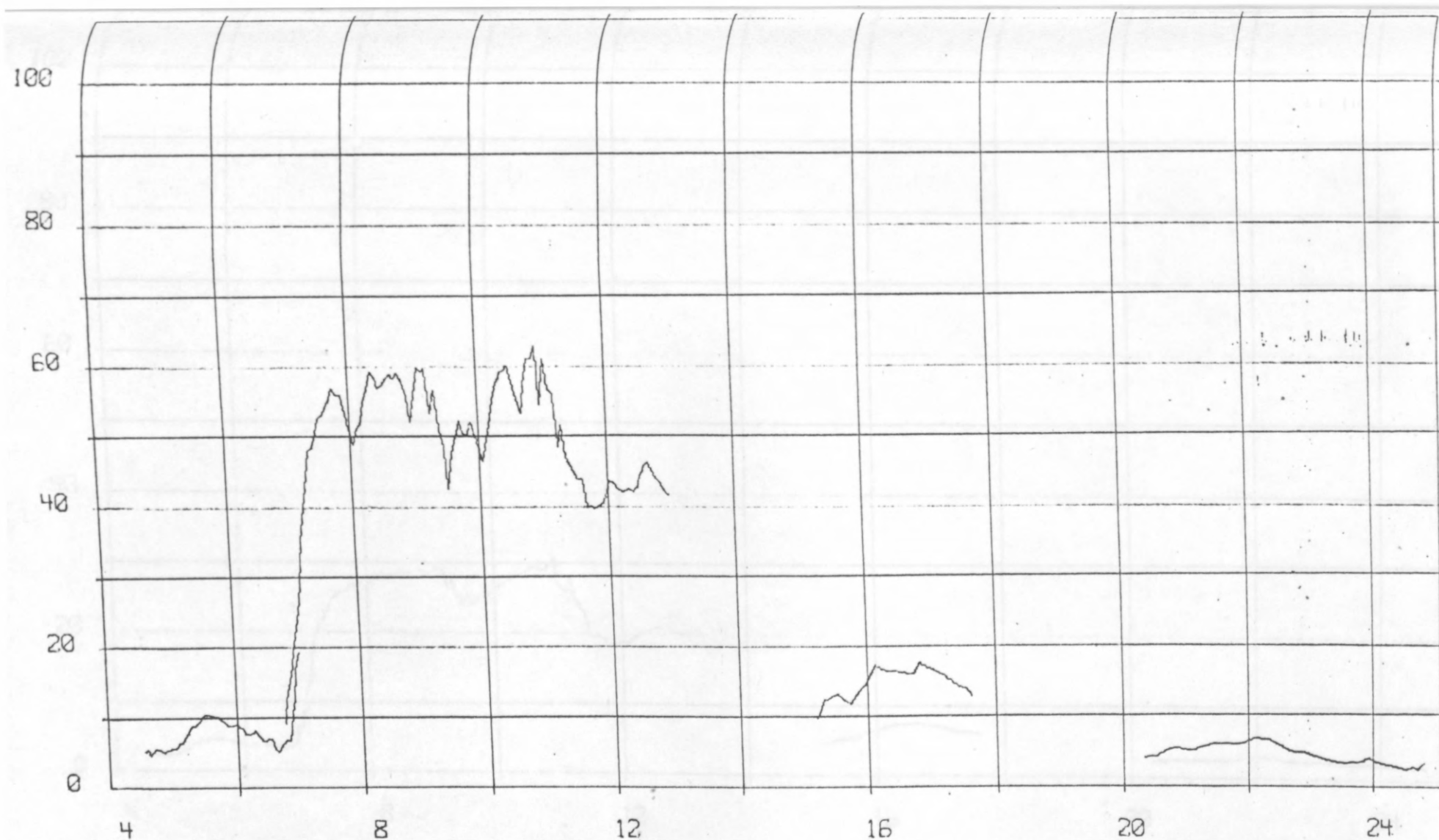
3 AUG 77

TINTIC, UTAH, TAPE (1) SITE: D-49/P. MONOPHYLLA

156/157

ABSOLUTE REFLECTANCE

Fig. 91 Pinus monophylla



WAVELENGTH (TENTHS OF MICROMETERS)

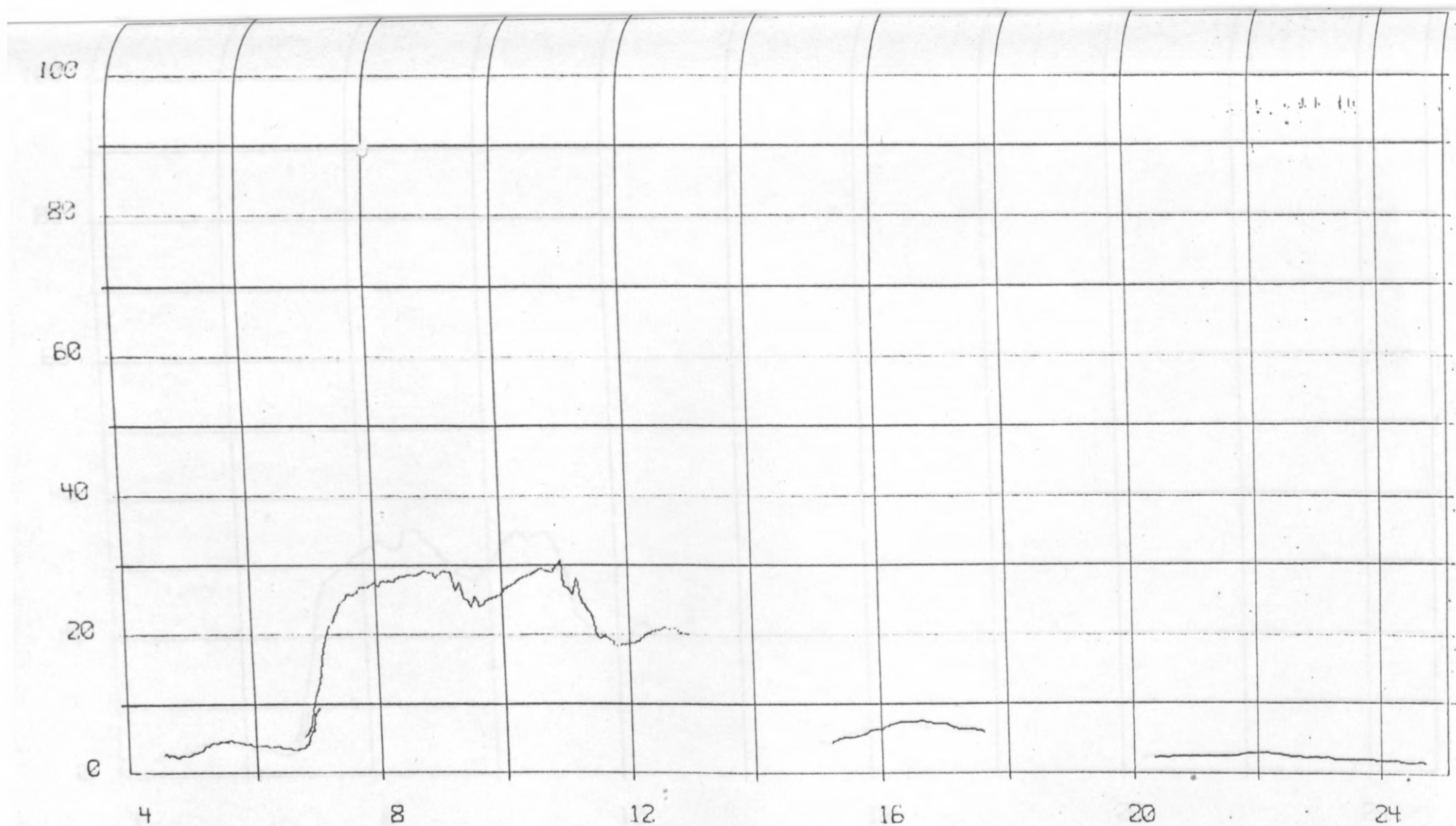
7 AUG 77

TINTIC, UTAH, TAPE (4) SITE: C-39/SNGL LEAF PINE

210/211

ABSOLUTE REFLECTANCE

Fig. 92 Pinus monophylla



WAVELENGTH (TENTHS OF MICROMETERS)

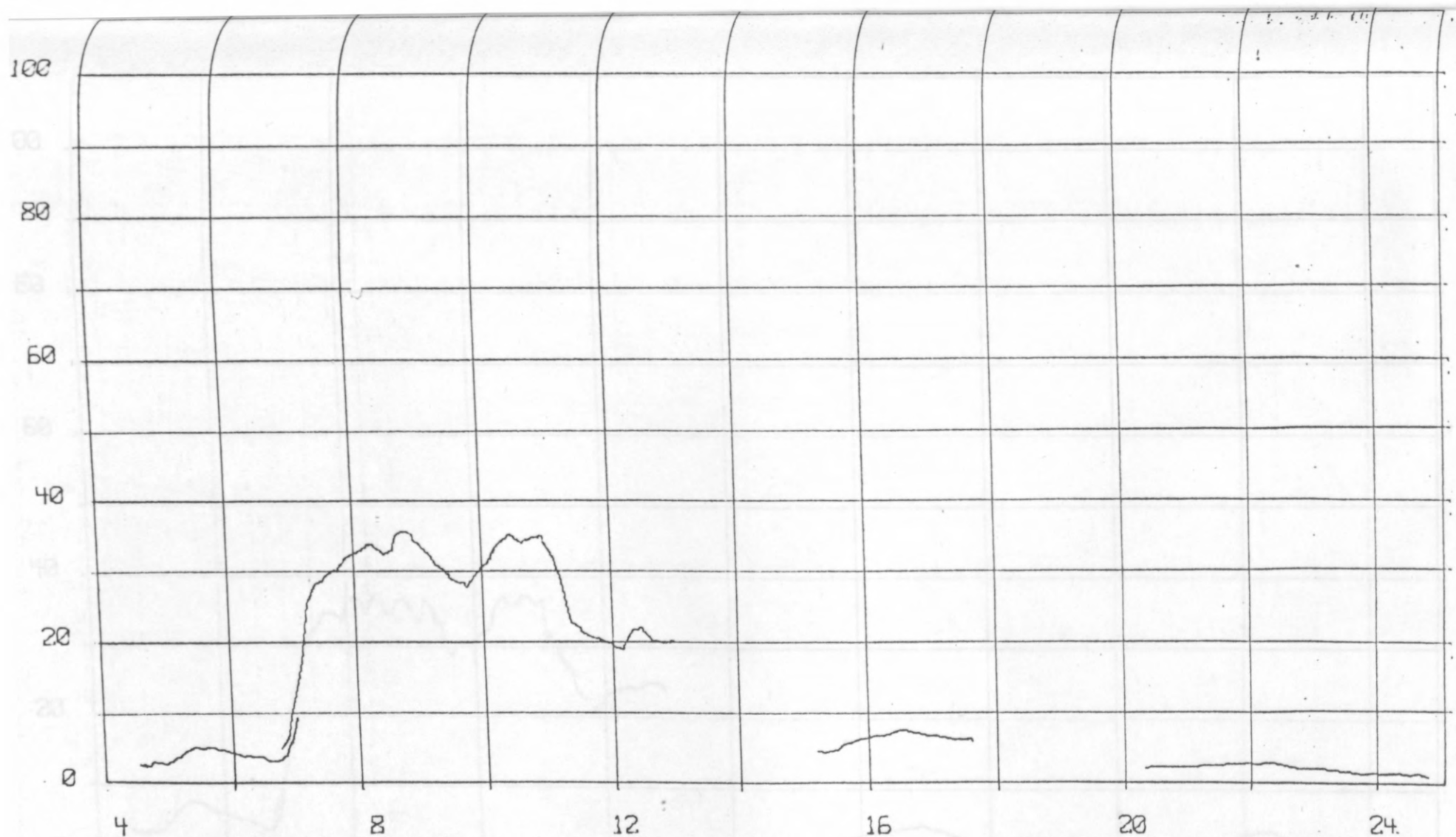
7 AUG 77

TINTIC, UTAH, TAPE (4) SITE: D-50/SNGL LFAF PINE

242/243

ABSOLUTE REFLECTANCE

Fig. 93 Pinus monophylla



WAVELENGTH (TENTHS OF MICROMETERS)

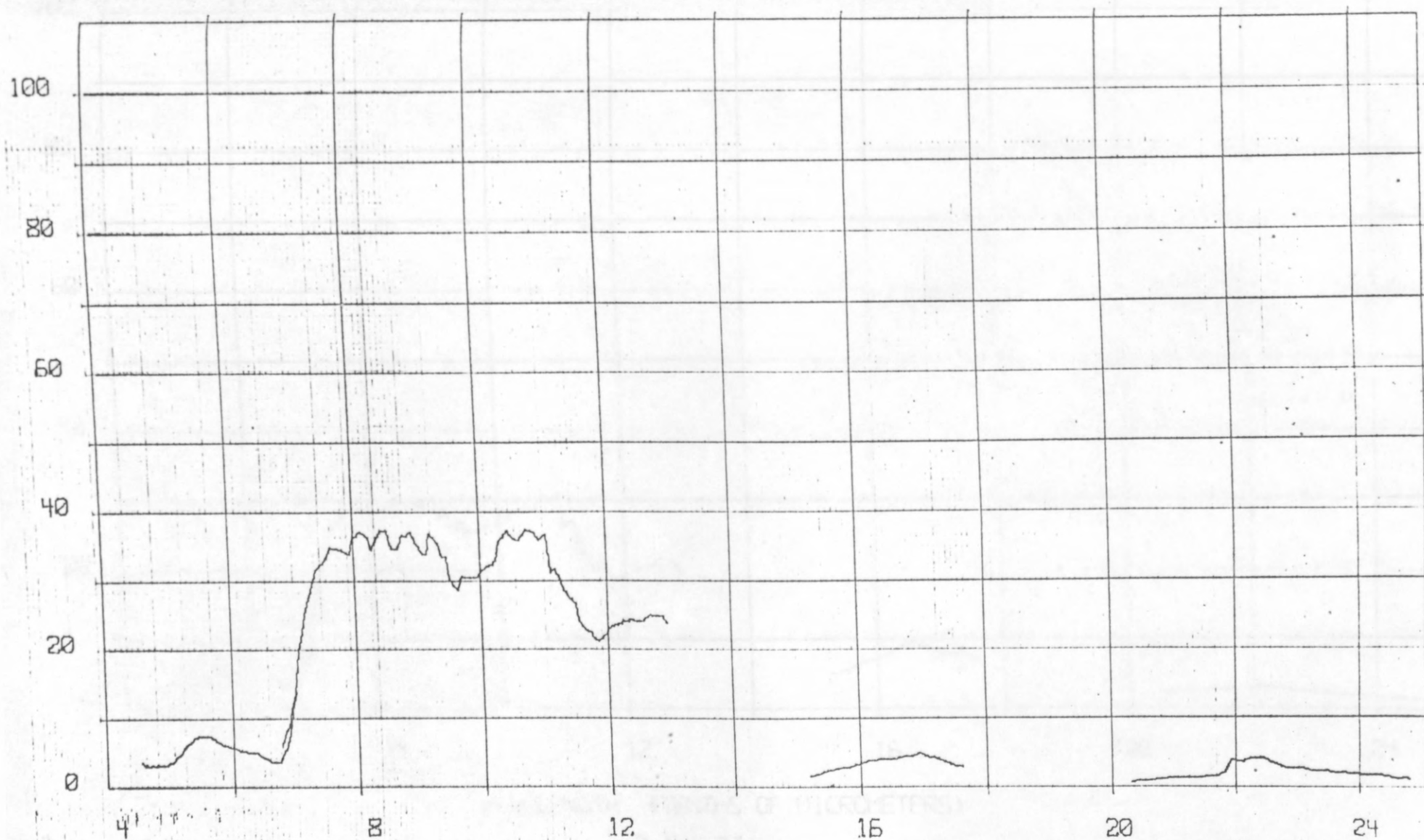
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: B-44/PINYON-PINON

111/113

ABSOLUTE REFLECTANCE

Fig. 94 *Pinus monophylla*



WAVELENGTH (TENTHS OF MICROMETERS)

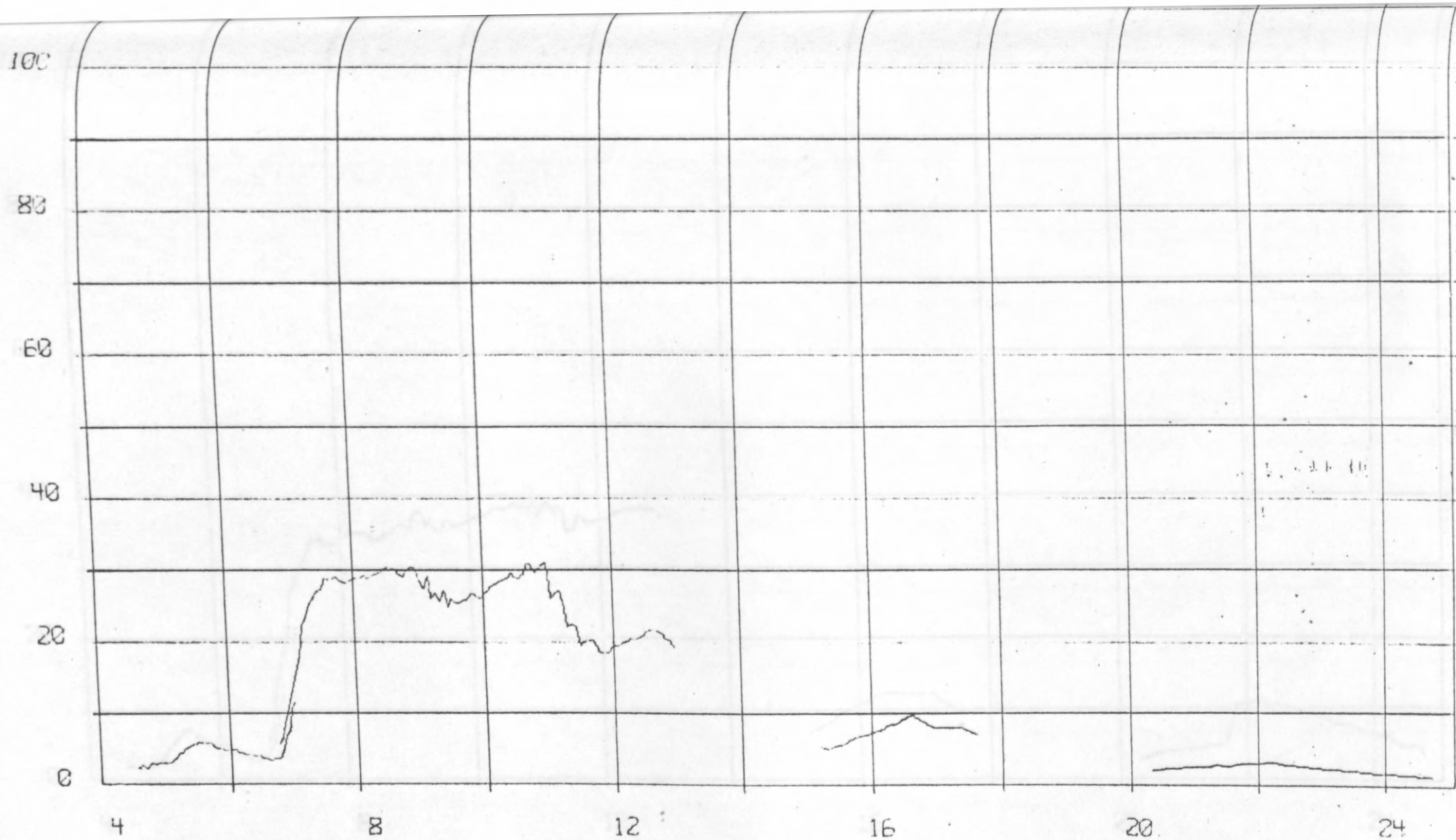
9 AUG 77

TINTIC, UTAH, TAPE ⁹(10) SITE: F-81/PINE

155/157

ABSOLUTE REFLECTANCE

Fig. 95 *Pinus monophylla*



WAVELENGTH (TENTHS OF MICROMETERS)

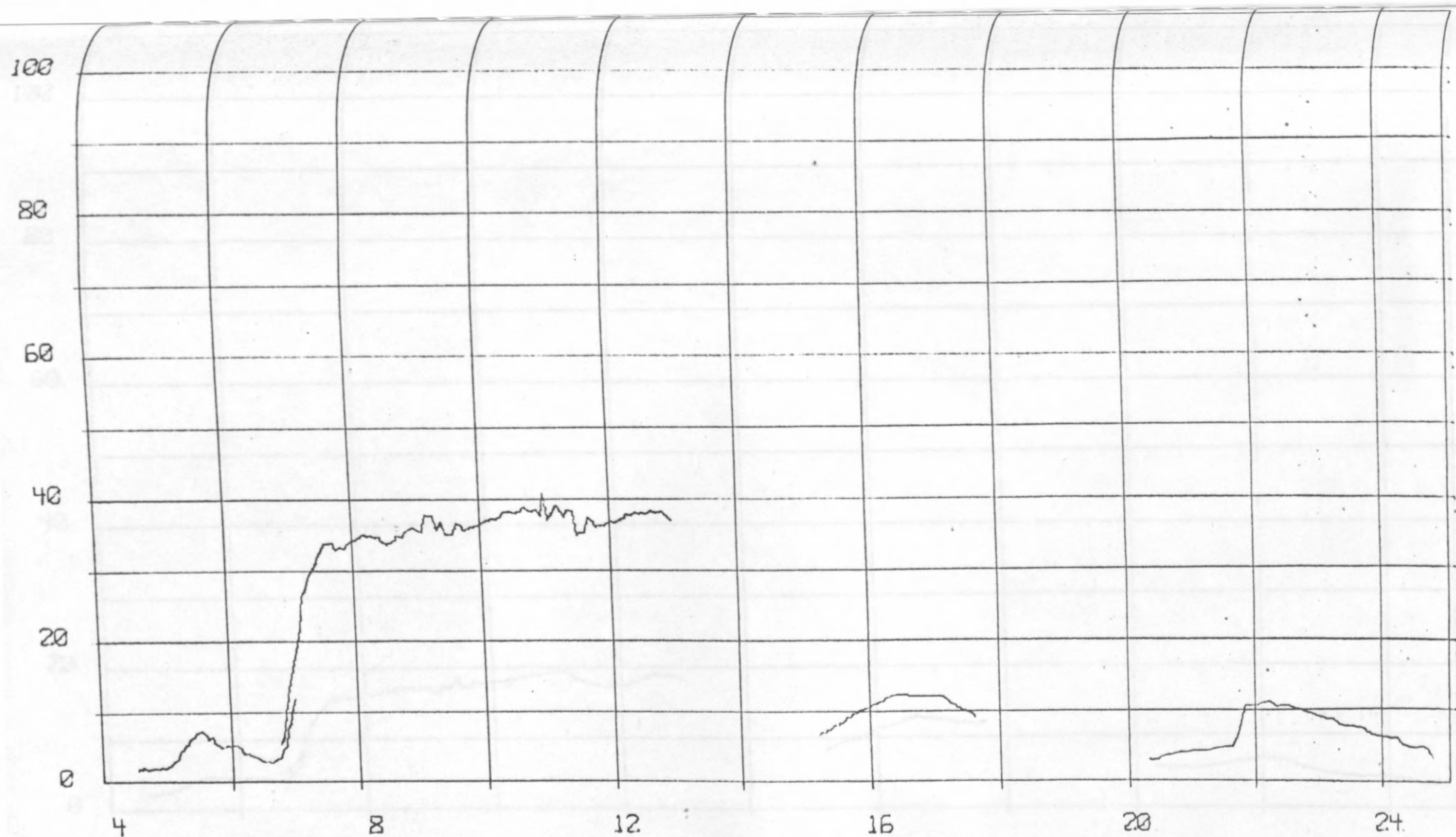
7 AUG 77

TINTIC, UTAH, TAPE (4) SITE: E-66/SNGL LEAF PINE

312/313

ABSOLUTE REFLECTANCE

Fig. 96 Pinus monophylla



WAVELENGTH (TENTHS OF MICROMETERS)

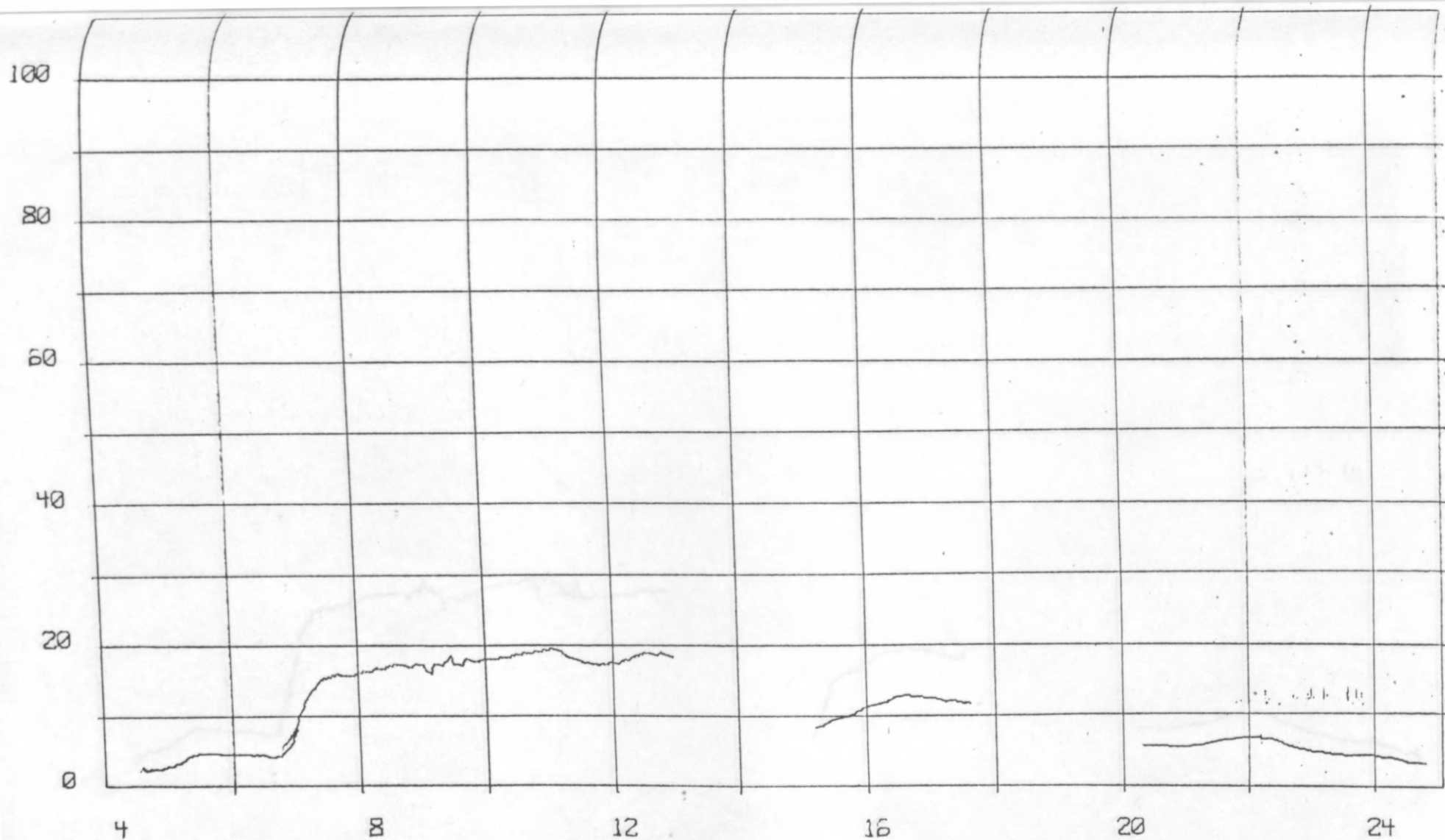
8 AUG 77

TINTIC, UTAH, TAPE (6) SITE: D-68/BIGTOOTH MAPLE

273/277

ABSOLUTE REFLECTANCE

Fig. 97 Acer grandidentatum



WAVELENGTH (TENTHS OF MICROMETERS)

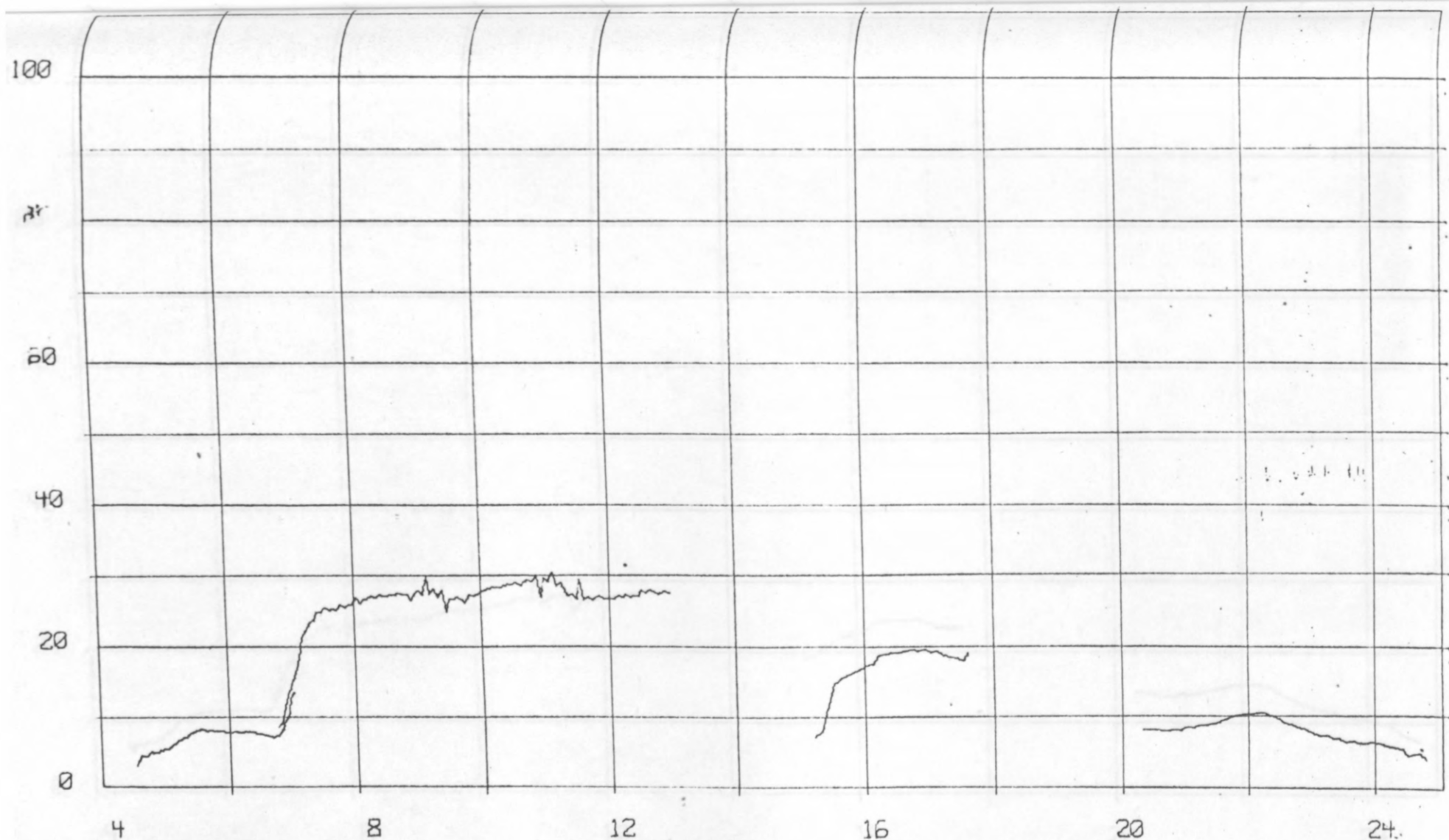
8 AUG 77

TINTIC, UTAH, TAPE (58) SITE: A-25/RICE GRASS

125/127

ABSOLUTE REFLECTANCE

Fig. 98 Oryzopsis hymenoides



WAVELENGTH (TENTHS OF MICROMETERS)

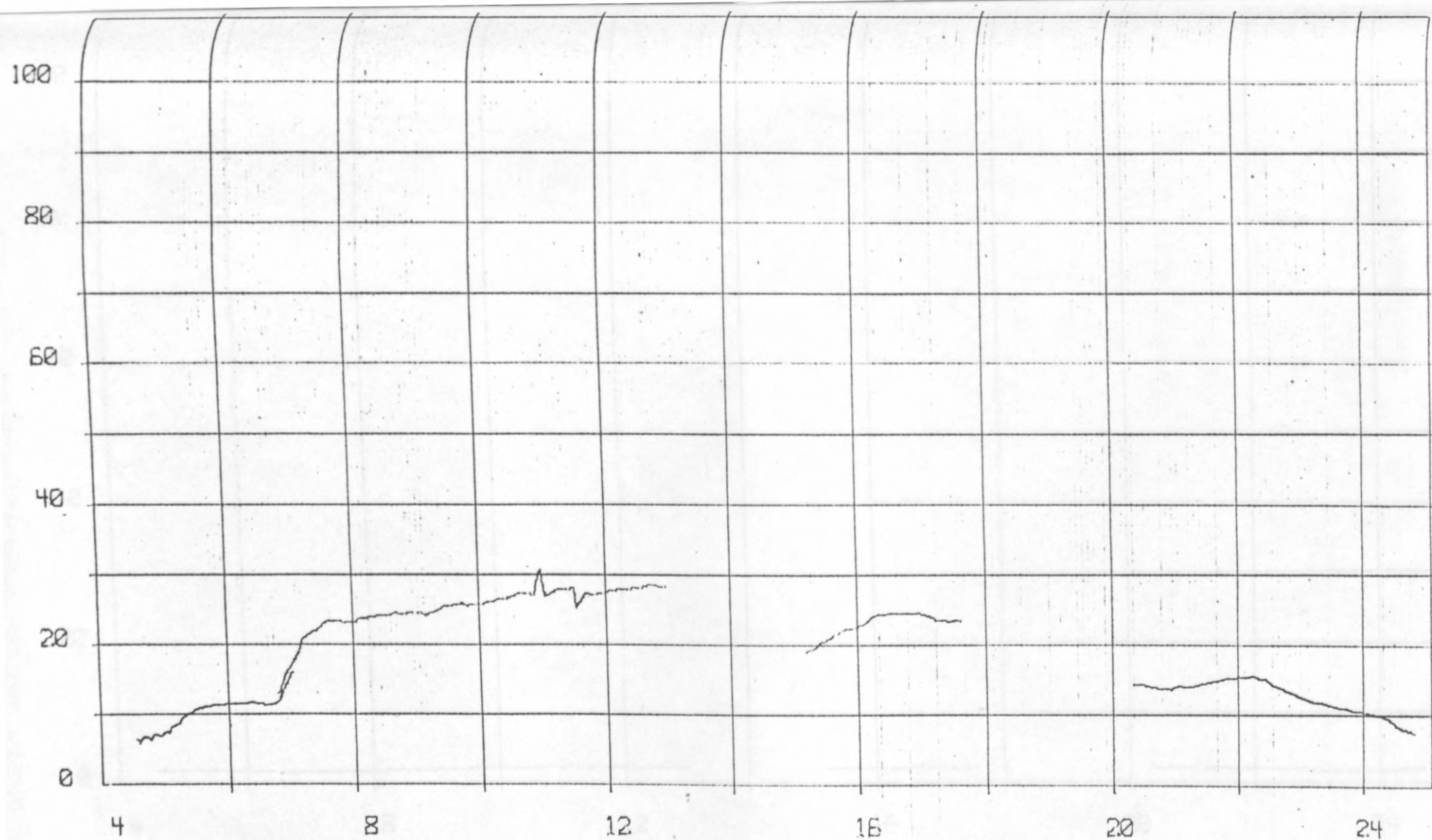
➤ AUG 77

TINTIC, UTAH, TAPE (5B) SITE: A-9/GRASS-ASK NANCY

025/026

ABSOLUTE REFLECTANCE

Fig. 99 Grass



WAVELENGTH (TENTHS OF MICROMETERS)

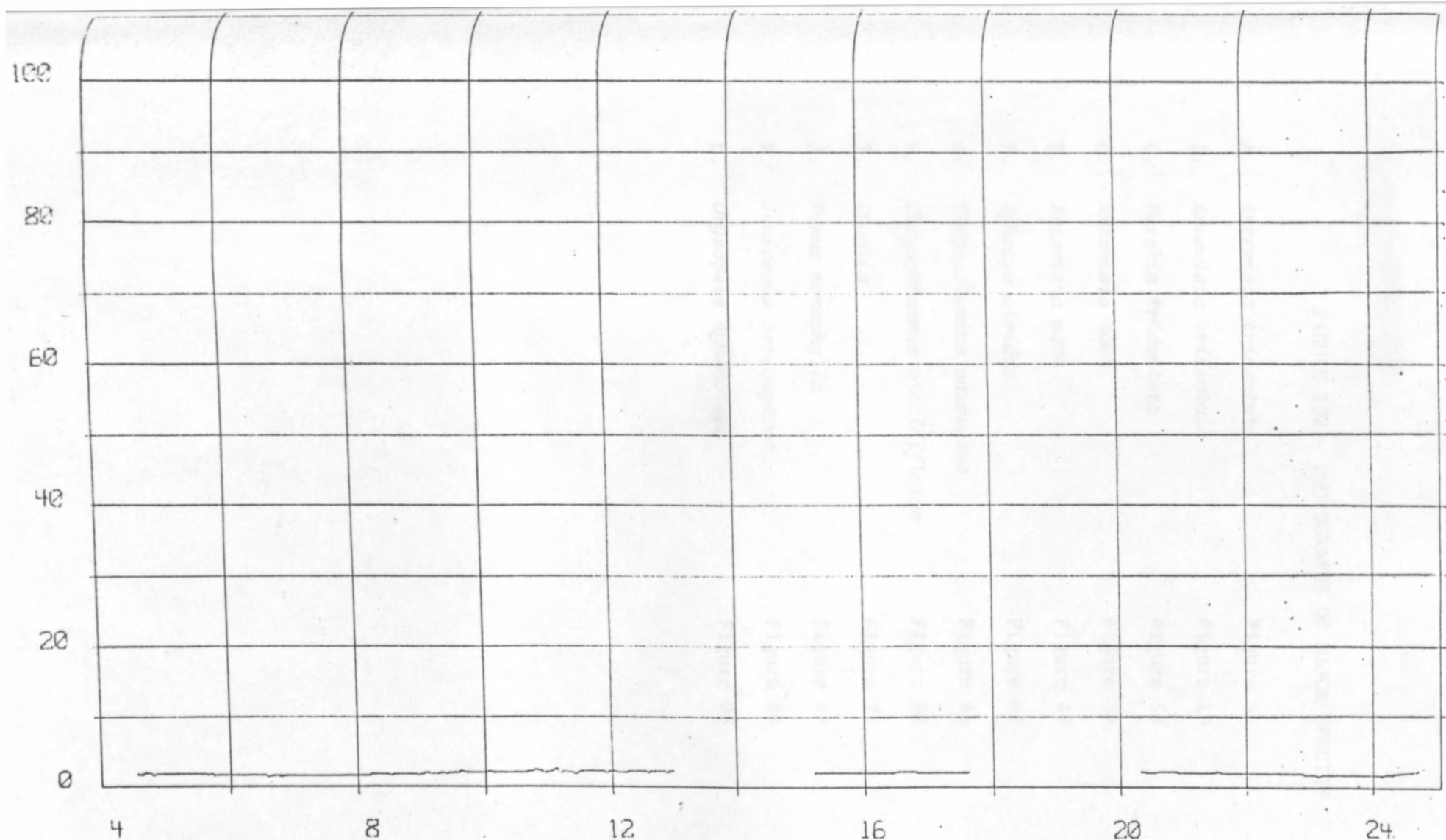
9 AUG 77

TINTIC, UTAH, TAPE (8) SITE: A-15/GRASS

067/071

ABSOLUTE REFLECTANCE

Fig. 100 Grass



WAVELENGTH (TENTHS OF MICROMETERS)

3 AUG 77

TINTIC, UTAH. TAPE (1) SITE: HEFTY BAG

074/075

ABSOLUTE REFLECTANCE

Fig. 101 Black plastic

FIGURE 102 - PHOTOGRAPHS OF MAJOR SPECIES

A.	<i>Artemisia tridentata</i>	Figure 5
B.	<i>Artemisia tridentata</i>	Figure 19
C.	<i>Purshia tridentata</i>	Figure 59
D.	<i>Artemisia nova</i>	Figure 39
E.	<i>Artemisia nova</i>	Figure 42
F.	<i>Ephedra viridis</i>	Figure 68
G.	<i>Chrysothamnus nauseosus</i>	Figure 45
H.	<i>Chrysothamnus viscidiflorus</i>	Figure 54
I.	<i>Opuntia</i>	Figure 74
J.	<i>Pinus monophylla</i>	Figure 94
K.	<i>Juniperus osteosperma</i>	Figure 88
L.	<i>Oryzopsis hymenoides</i>	Figure 98

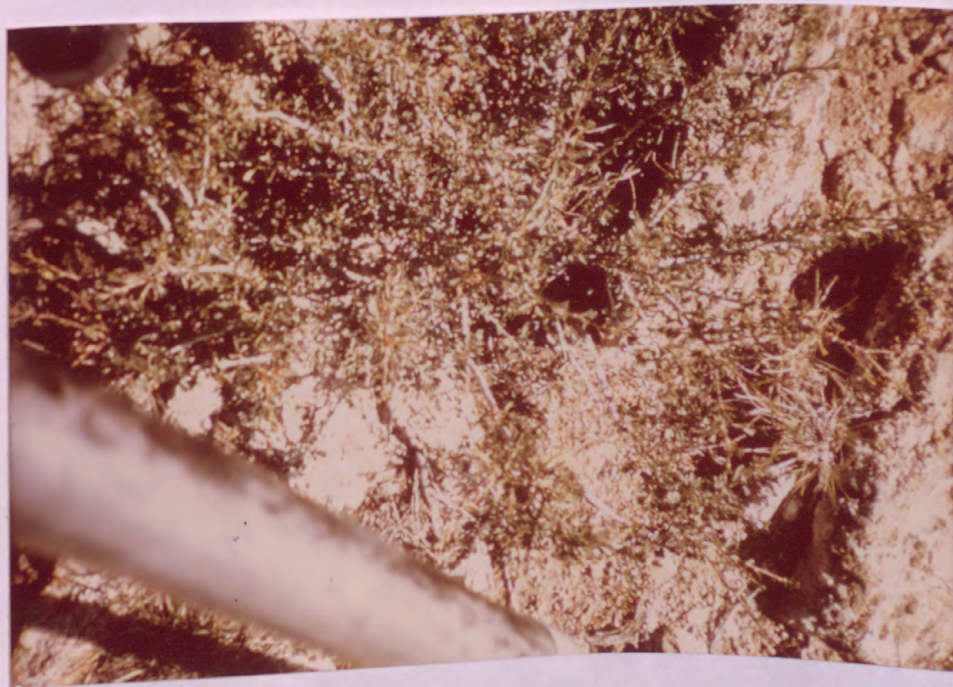


A



B

C



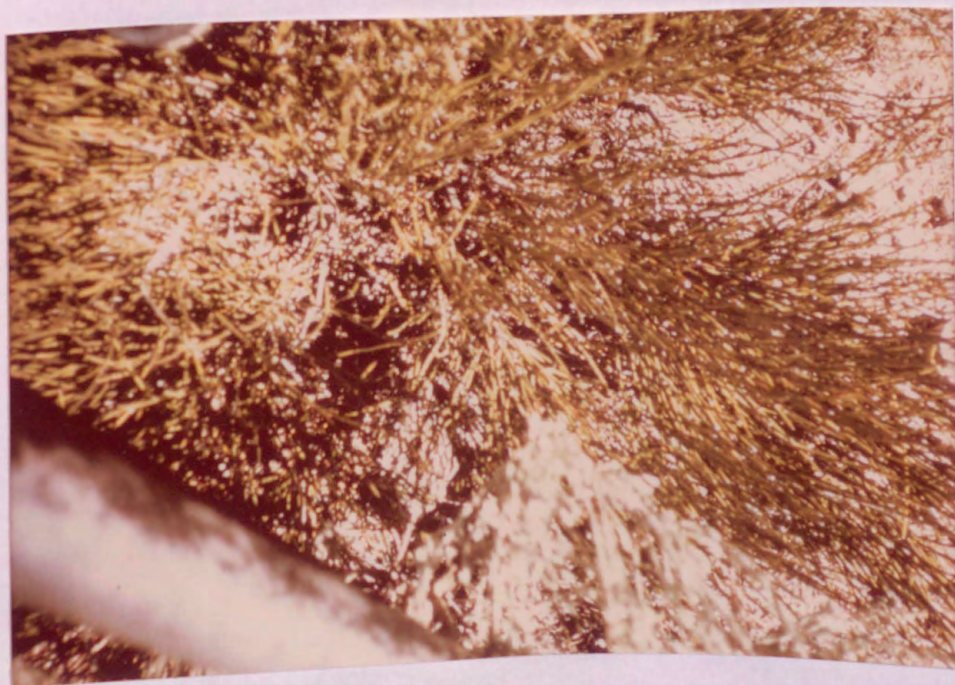


D



E

F





G



H

I





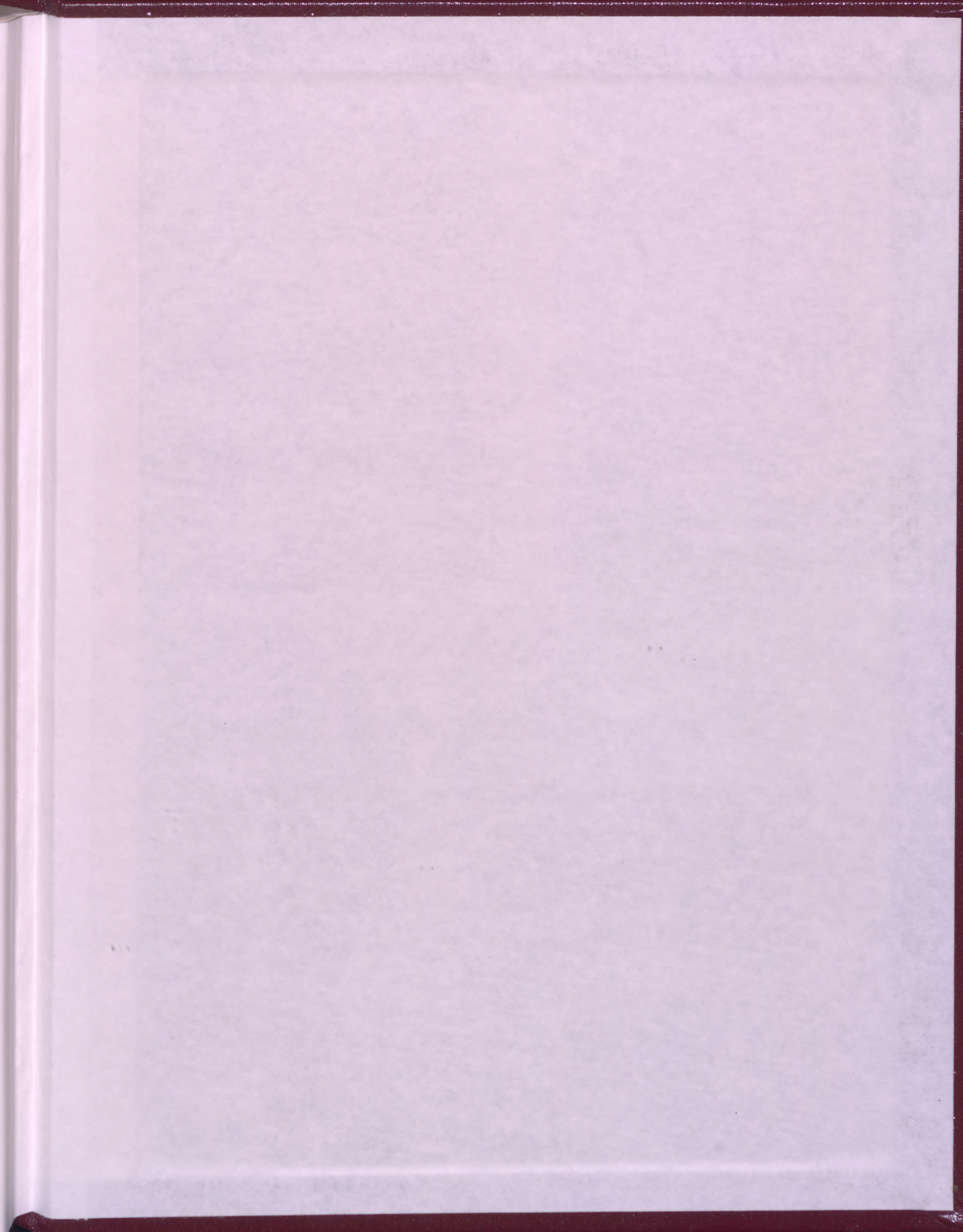
J



K

L





USGS LIBRARY-RESTON



3 1818 00069515 3