Technical Report No. 95

MICROBIAL BIOMASS MEASUREMENTS AT THE PANTEX SITE, 1970

Ernest P. Boulette III, Ralph C. Porter,

and Robert W. Gorden

Texas Tech University

Lubbock, Texas

GRASSLAND BIOME

U. S. International Biological Program

April 1971

TABLE OF CONTENTS

ABSTRACT

A study of microbial populations and decomposition of the shortgrass prairie was started in May of 1970 supported by IBP on the Pantex Site. The study was to be conducted in two parts: first, a study of the viable bacterial population over a period of time using the standard plate count technique, and second, a study of microbial decomposition using the litter bag method.

INTRODUCTION

The Pantex Site is located 15 miles east of Amarillo, Texas, on the Texas Tech University Research Farm. This site is in the northeast corner of the Llano Estacado, a plateau without prominent topographic features with an area of 20,000 square miles. The vegetation of the site area is predominately blue grama intermixed with abundant prickly pear. The climate is very dry and subject to rapid and widespread temperature changes with a strong prevailing wind. Pullman silty clay loam is the characteristic soil of this area.

MATERIAL AND METHODS

Testing Sites

Two areas approximately one mile apart were used in this study. The ungrazed study area, Treatment 1, is a 35-acre pasture located on land belonging to the Atomic Energy Commission. This area has been ungrazed for four years. The grazed study site is a 158-acre pasture which is divided into two sections. Treatment 3 represents an area which was moderately grazed by cattle for two years, during 1968 and 1969. Treatment 5 was grazed in 1969 and remained ungrazed in 1970. Each of the three treatments was further subdivided into two replicates.

Bacterial Population Studies

Samples were gathered bimonthly from May 2, 1970 until September 1, 1970. Samples for October and November were taken on a monthly basis.

Sample cores were taken to a depth of 90 cm with a hydraulic corer. Six cores were taken randomly from each replicate. The cores were removed from the corer and divided into five different depths;

Depth 1 0-5 cm

Depth 2 5-10 cm

Depth 3 10-20 cm

Depth 4 20-50 cm

Depth 5 50-90 cm

In each replicate, 3 g samples from each of the six cores and from a specific depth were pooled to provide a representative sample. Each replicate area thus has five different samples collectively representing a depth from 0 to 90 cm.

Each sample was pulverized, mixed, and a 1 g sample weighed and placed in 99 ml of sterile distilled water. Five drops of Tween-80 were added to the suspension, and the sample was shaken for three to five minutes and then appropriate serial dilutions of the sample were prepared. Pour plates using standard methods and "Plate Count Agar" were prepared in triplicate. The plates were incubated at 23°C for seven days before the colonies were counted.

Decomposition Study

Rates of decomposition were studied by the use of litter bags. The bags used were approximately four inches square and were made of two

different types of material, nylon parachute cloth with a microscopic pore size and a large mesh rayon cloth. Two types of grass were used in the study: native Pantex grass and a known blue grama grass as a control. Weighed and numbered samples were placed on the surface of a plot within the Pantex Site. Samples were retrieved at monthly intervals. Upon collection, the sample material was removed from the bag and dried at 60°C for 24 hours. The material was then weighed, ashed, and reweighed.

RESULTS

Tables 1 and 2, and Fig. 1 through 8 present the results obtained during the determination of the number of viable bacterial cells per gram of soil in each sample during a period of 195 days. Fig. 1 through 5 show the numbers of bacteria of each treatment at a given depth. The results indicate that there was no significant difference among the three treatment areas. The number of viable bacteria varied greatly from week to week in the first 20 cm of soil, but there was little variation in samples taken at greater depths. The trend in the results indicates a decrease in numbers with increasing depth.

Results from the study of litter decomposition are presented in Fig. 9. The results are contradictory in that opposite results were obtained with the Pantex grass and blue grama in relation to mesh size of the litter bags. The results were further confused because the rayon material decomposed when the second sample was taken at three months, resulting in some unknown loss of the sample material.

Table 1. Bacterial numbers on sampling dates.

Days	Depth	Cells/gm ($\times 10^6$)		
		Treatment 1	Treatment 5	Treatment 3
1	1	17.6	5.2	8.7
	2	18.5	4.8	10.3
	3	11.8	6.2	8.3
	4	32.7	9.8	9.3
	5	20.0	5.9	7.2
15	1	1.4	1.5	2.2
	2	1.7	1.8	8.5
	3	2.0	1.8	1.5
	4	1.5	5.0	0.2
	5	0.7	0.7	0.1
31	1	1.6	0.2	0.8
	2	2.7	0.1	1.2
	3	1.4	0.2	0.8
	4	0.3	0.2	0.5
	5	0.4	0.1	0.3
46	1	1.1	4.3	3.8
	2	1.1	0.8	4.2
	3	3.4	0.6	0.8
	4	1.6	0.8	0.4
	5	2.4	0.4	0.5
60	1	31.2	10.3	6.7
	2	17.9	4.6	3.0
	3	1.6	1.1	0.7
	4	1.1	0.9	0.7
	5	0.7	0.9	0.7
74	1	8.5	6.7	11.2
	2	8.7	14.2	1.9
	3	3.7	3.1	1.8
	4	1.3	1.5	0.6
	5	1.1	0.8	0.8

Table 2. Bacterial numbers on sampling dates.

Days	Depth	Cells/gm (x 10^6)		
		Treatment 1	Treatment 5	Treatment 3
90	1	8.0	3.1	4.7
	2	4.4	1.4	4.4
	3	9.8	0.9	0.9
	4	0.8	0.8	0.7
	5	1.1	0.7	0.5
102	1	1.5	6.8	5.6
	2	1.5	3.2	0.9
	3	0.5	0.9	1.2
	4	0.3	0.6	1.4
	5	0.4	0.7	0.7
119	1	2.0	4.0	5.0
	2	2.0	4.0	1.0
	3	0.6	0.9	1.1
	4	0.4	0.7	1.1
	5	0.7	0.6	0.5
152	1	6.8	10.0	38.0
	2	9.0	19.0	14.0
	3	3.5	6.0	7.4
	4	0.2	0.9	0.8
	5	0.7	0.8	0.4
196	1	9.1	3.0	2.0
	2	6.8	1.1	3.0
	3	2.0	0.7	0.6
	4	1.5	0.6	0.4
	5	0.9	0.7	0.5

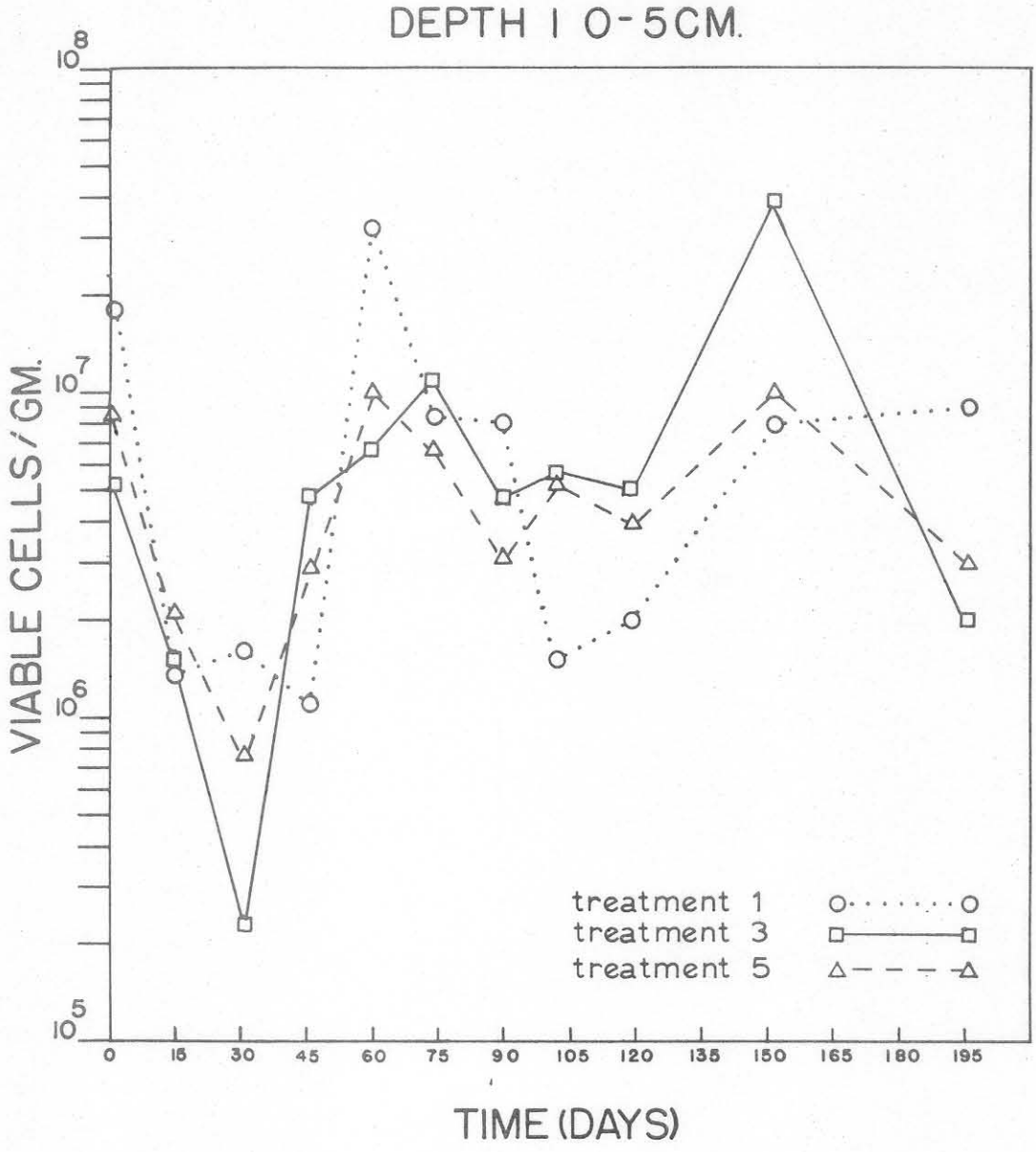

Fig. 1. Number of viable cells at depth 1 0-5cm.

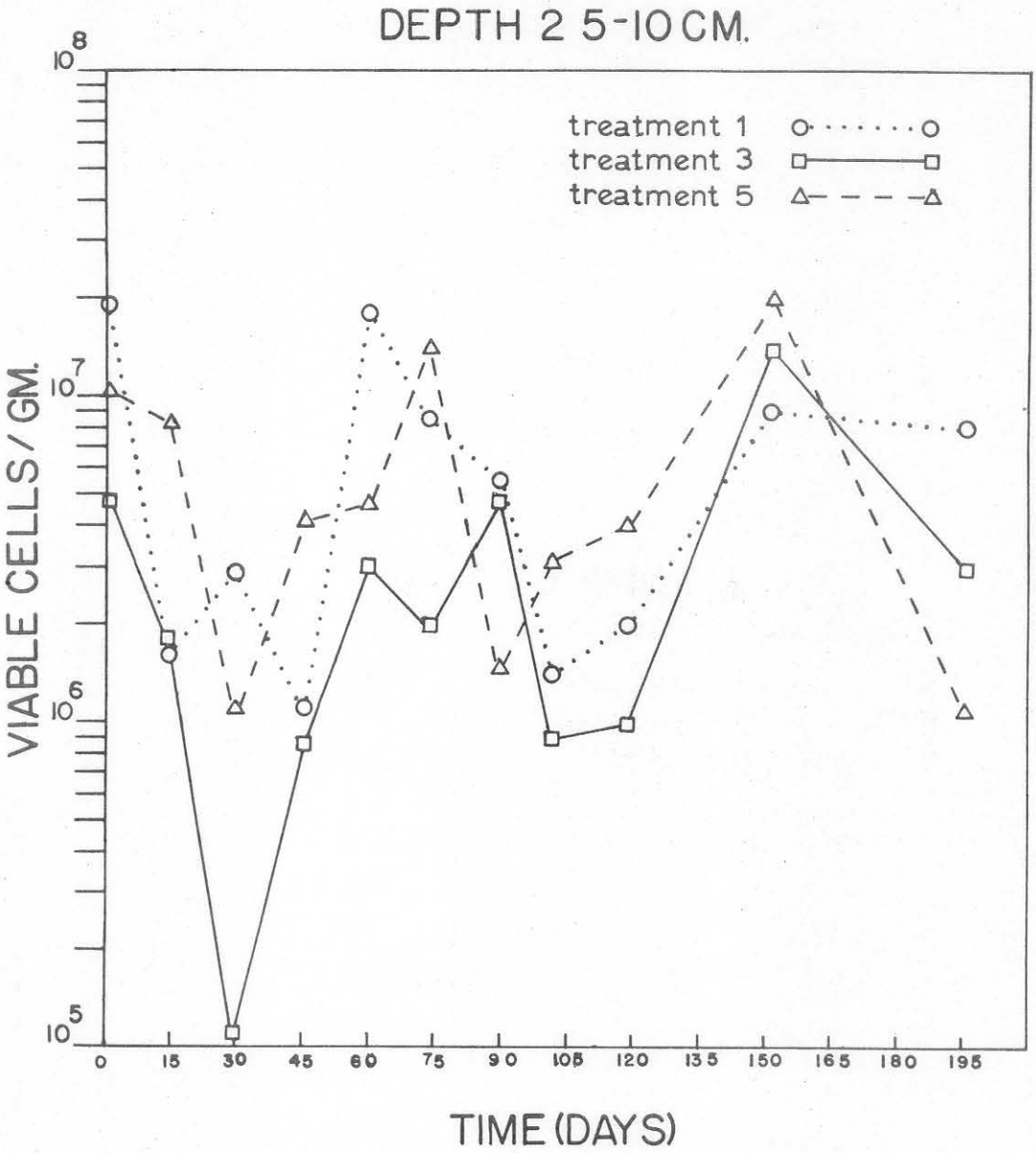

Fig. 2. Number of viable cells at depth 2 5-10cm.

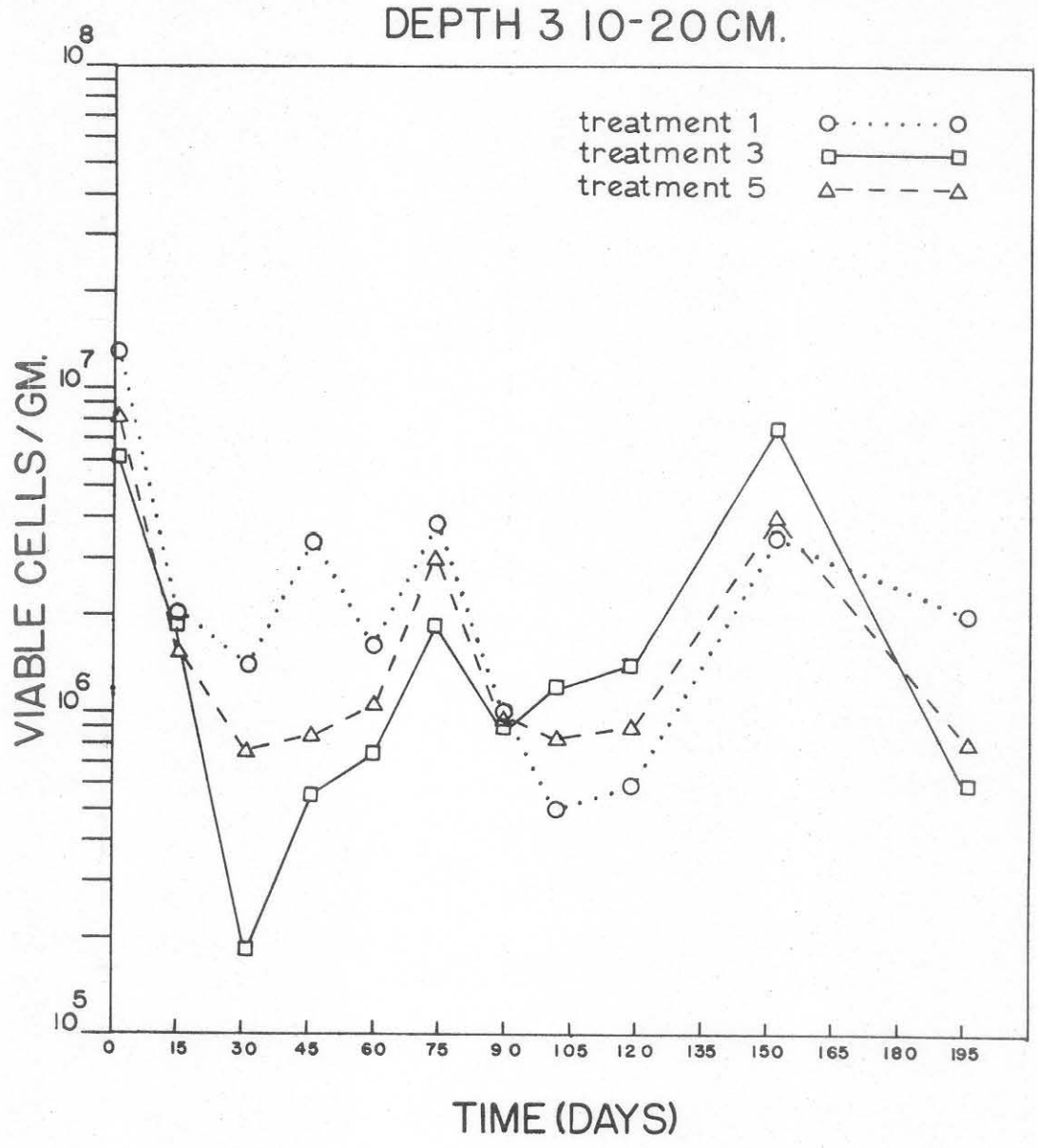

Fig. 3. Number of viable cells at depth 3 10-20cm.

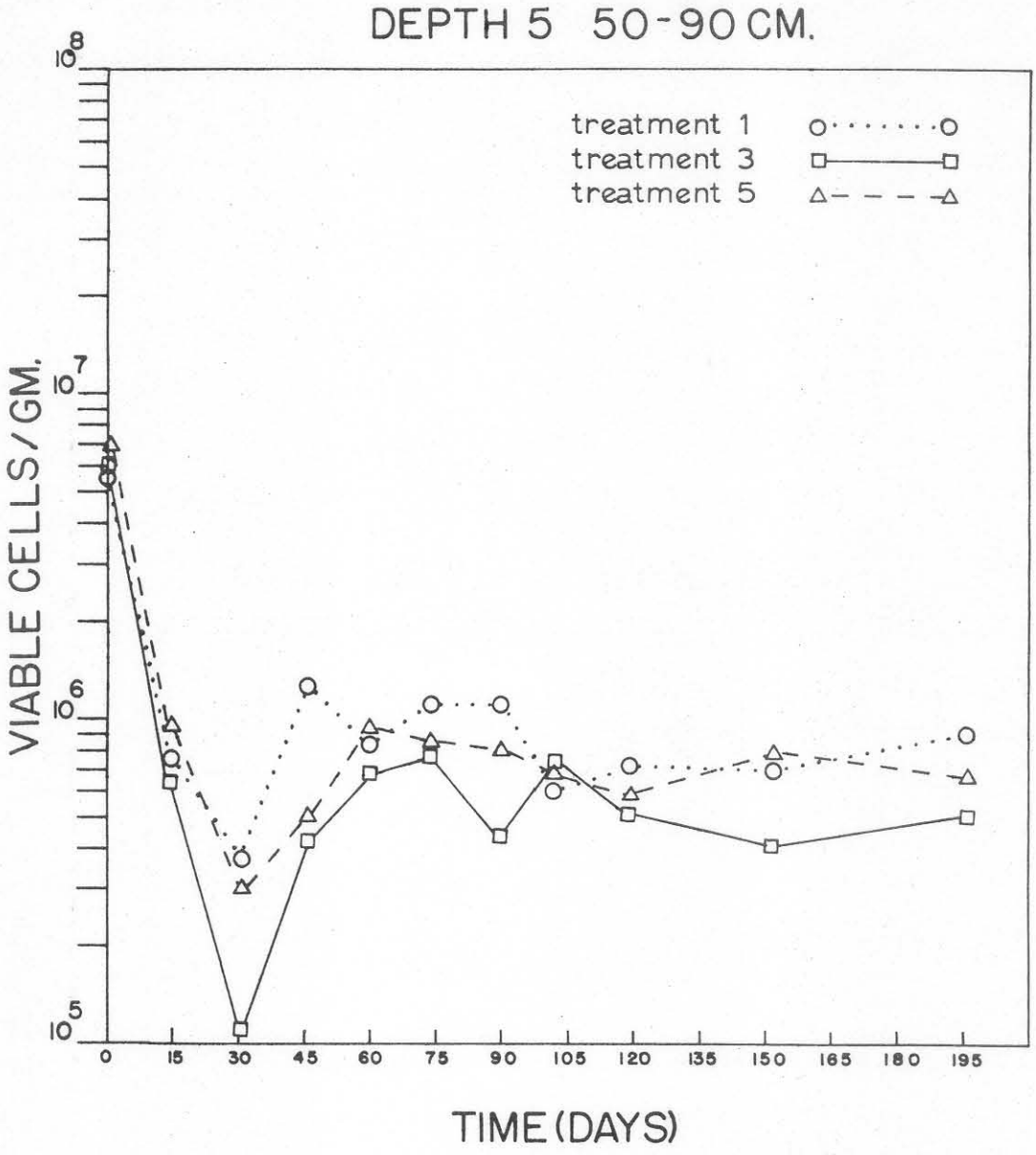

Fig. 5. Number of viable cells at depth 5 50-90cm.

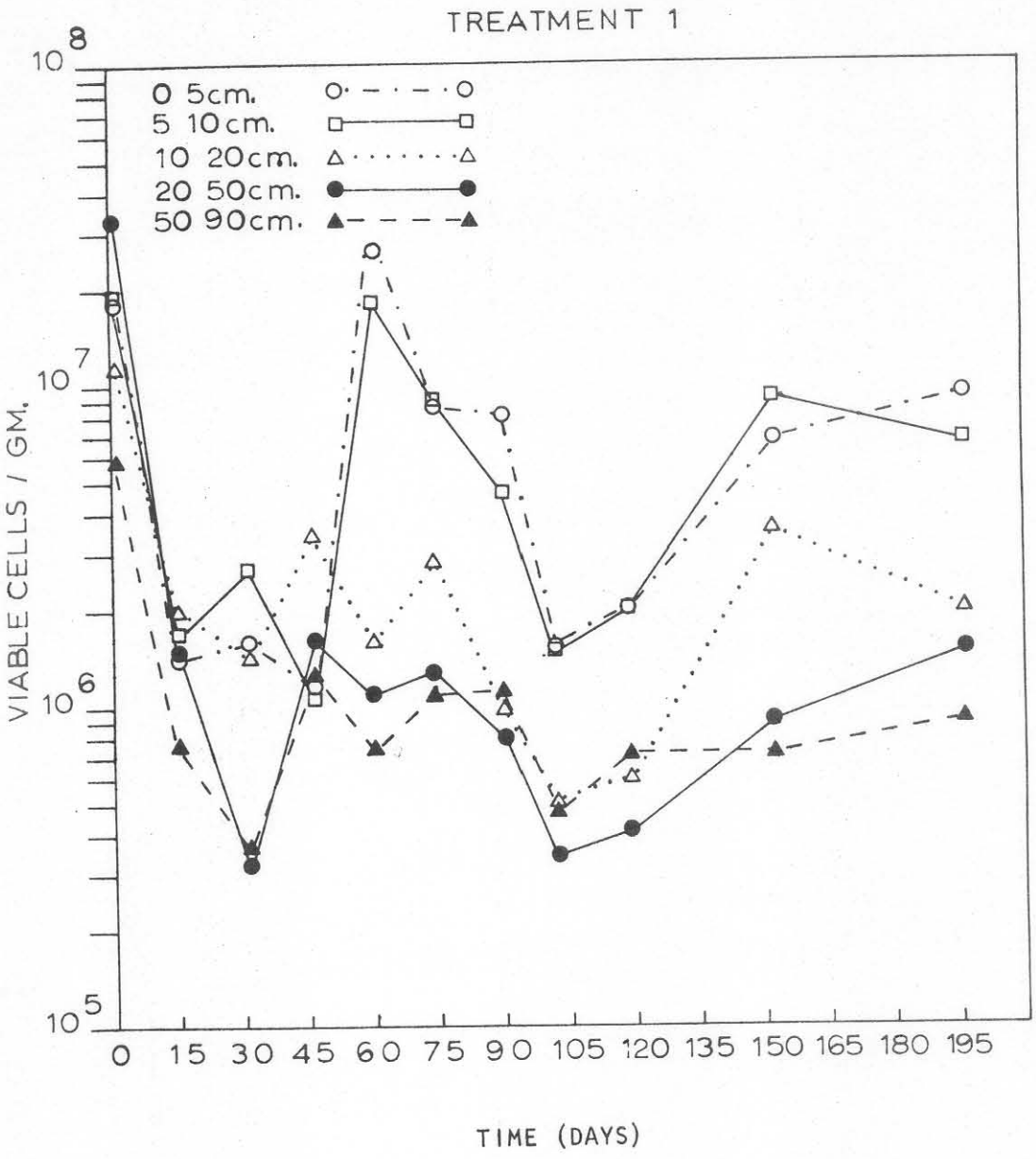

Fig. 6. Number of viable cells at depths of treatment 1.

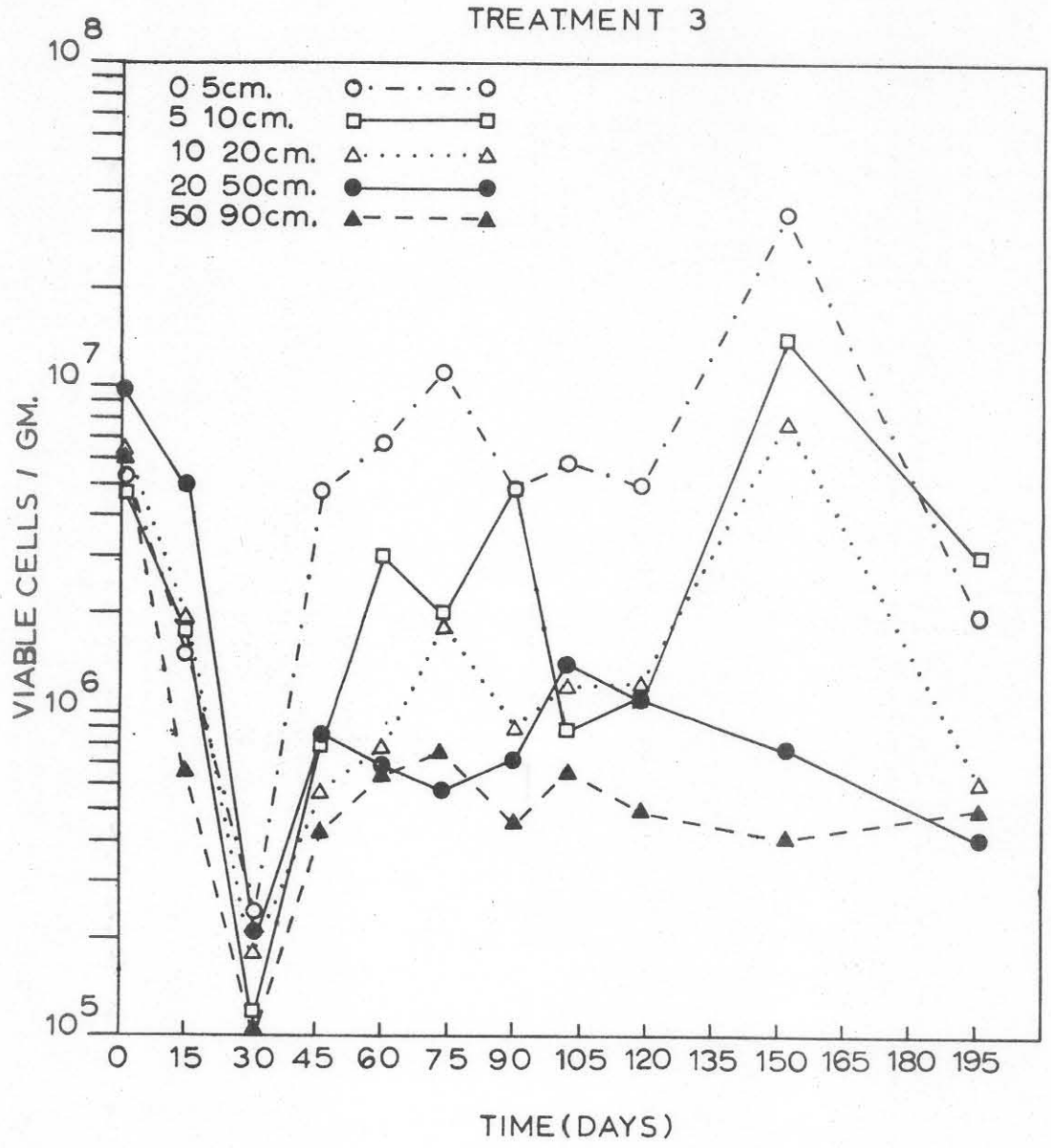

Fig. 7. Number of viable cells at depth of treatment 3.

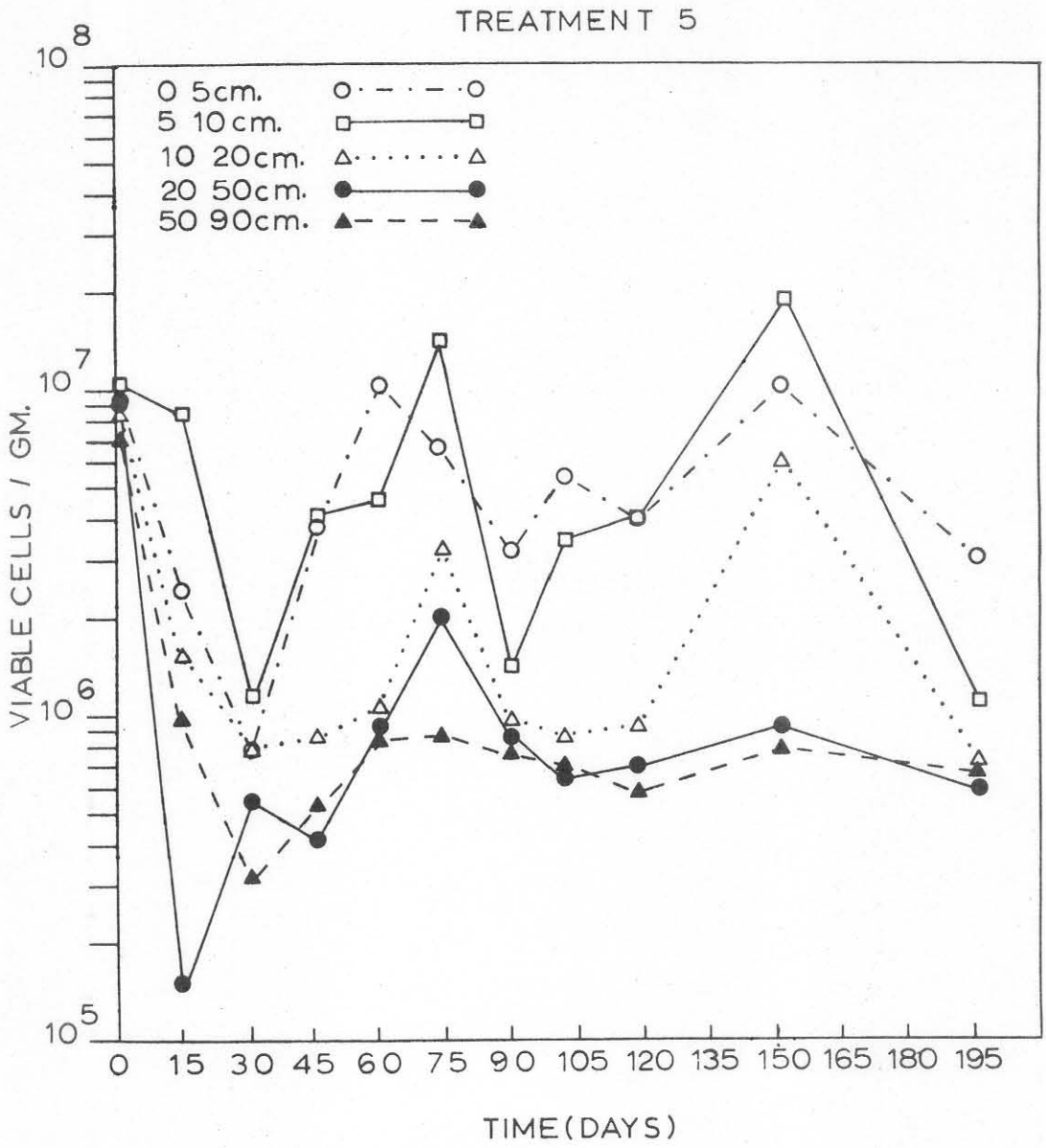

Fig. 8, Number of viable cells at depths of treatment 5.

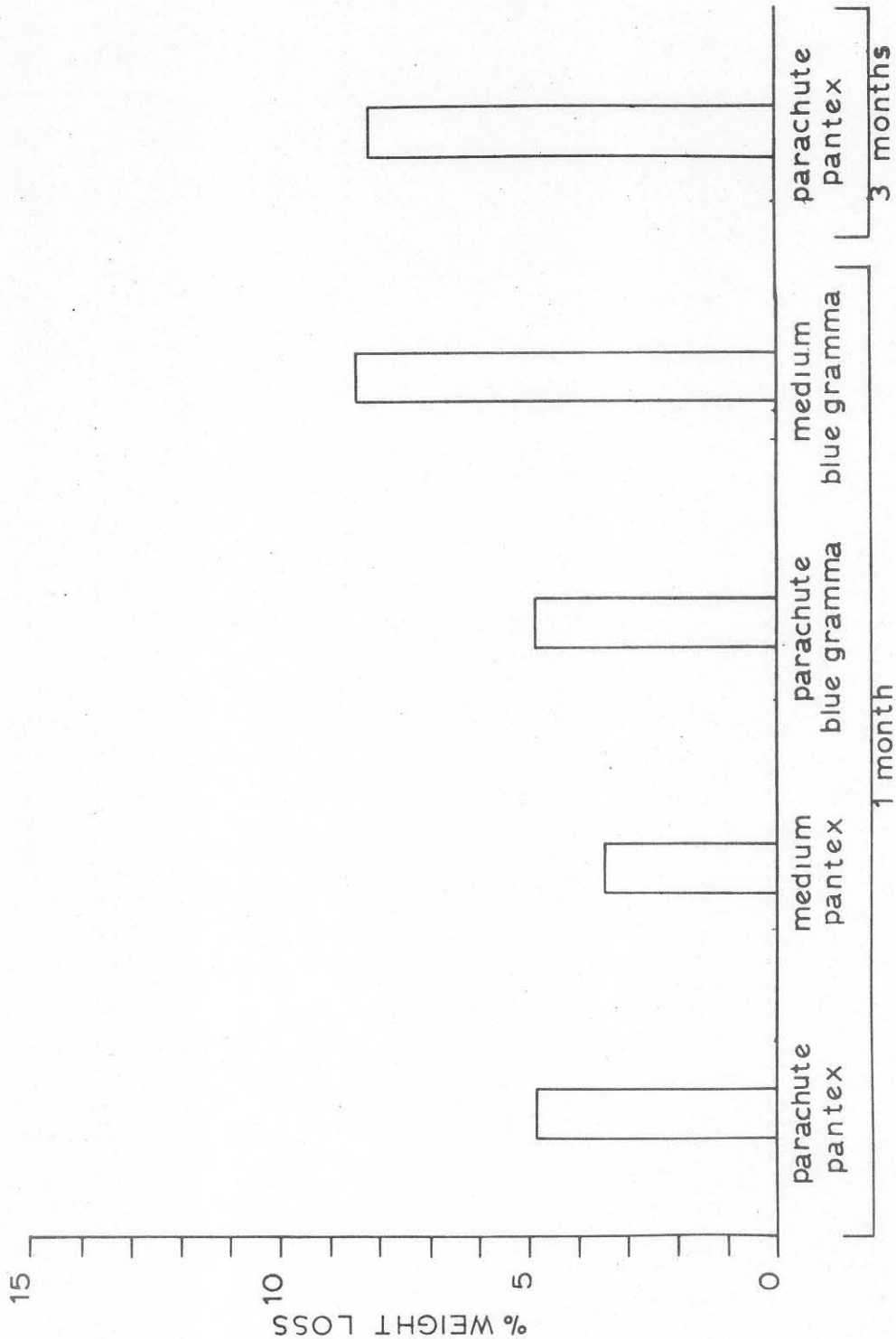

Fig. 9. Litter bag decomposition data.

DISCUSSION

The marked fluctuation in the microbial biomass in the first 10 cm of soil may be due to any number of factors such as grazing, available nutrients, and moisture. Since no statistically significant differences were observed which were due to treatments (e.g., grazing and also as a result, nutrients) then it seems probable that available moisture may have been the controlling factor in these results.

ACKNOWLEDGMENT

We acknowledge the laboratory assistance of Mrs. F. K. Pieratt and the technical advice of Dr. D. W. Thayer during the Fall of this year.