CHAPTER XV. DRAINAGE TRANSECT SOIL MOISTURE

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A. INTRODUCTION

One goal of the Washita '92 campaign was to observe the spatial and temporal change in soil moisture as it relates to regional hydrology. Particular focus was on monitoring the role of soil moisture in runoff generation using airborne ESTAR, SAR, and the 37 GHz sensors. A ground soil moisture sampling program was implemented in conjunction with the aircraft overflights to serve as ground truth to the microwave images. The sampling scheme was designed along several drainage transects in order to investigate the influence of topographic gradient, soils, and land cover on soil moisture distribution and redistribution during drydown.

B. STUDY AREA

The study area is the southwestern section of the Little Washita River basin. The region has rolling topography with a mixture of rangeland grasses and hardwood forests. Landuse is primarily pasture with some cultivation on the floodplain. The soils can be characterized as sandy or a sandy-loam mixture. More details about the soils and vegetation for each study site are given in Tables XV-1 and XV-2.

Eight individual fields were selected for analysis as shown in Figure XV-1. The main criterion for selection was sufficient change in relief within the field, preferably from hillcrest to valley bottom. In addition, differences resulting from different land coverages were desired. Transects were designed to include differences in landcover whenever possible. In general, the study sites are predominantly grassy rangeland that have developed on sandy soils.

C. SAMPLING PROCEDURE

To examine the geographic and temporal distribution of soil moisture, two parallel transects varying from 50 m to 200 m apart were sampled for each field. The transects were laid out to follow the path of natural drainage, from hillcrest to valley bottom. That would permit sampling of upland, mid-slope, and floodplain conditions. The transects were 300 m to 400 m in length on average. A sample was collected approximately every 50 m over the length of the transect. It was reasoned that the above sampling scheme provided a representative areal value for the field, and sufficient ground truth for calibration with the airborne sensor observations.

The procedure for the collection of the gravimetric soil moisture samples was similar to that discussed in an earlier chapter on the that topic. First the surface litter was brushed away and vegetation clipped to reveal the top surface of the soil. A spatula was then used to cut and remove a 5 cm deep square portion of the soil, thus exposing the soil column for sampling. After removal of the soil block, a wing trowel was then used to cut into the soil to remove a 5 cm horizontal by 5 cm vertical sample of the soil column. The sample was then placed and sealed in a canister to prevent moisture loss, and returned to the lab to for further processing. One soil moisture sample at a depth of 5-10 cm was also collected for each field. Once at the lab, the sample was unsealed and weighed in its can to obtain a wet weight for the sample. After weighing, the sample was placed in an oven at 100°C for twenty-four hours to dry. After drying the sample was then reweighed to obtain a dry weight, with the resultant weight loss being attributed to the amount of moisture originally present in the sample. This procedure was carried out for every day that there was an aircraft flight (6/10-6/14 and 6/16-6/18).

In addition to the collection of soil moisture samples, soil temperature data were collected at the depths of 5 cm and 15 cm at each sampling site along the transect. Notations were also made concerning the vegetative cover, soil characteristics, and other features worthy of note at each sampling site. Bulk density measurements were also conducted. Measurements were made at the beginning and end of every transect, thus there were four observations per transect field. The procedure for determining the soil bulk density is similar to the one outlined previously in the section concerning bulk density measurement.

D. RESULTS

The results are graphically displayed in Figures XV-2 to XV-7. Figure XV-2 contains a time series of the average gravimetric soil moisture from all the sampling sites within both transects of a given field in a given day. The actual point data from some transects are presented in Figures XV-3 - XV-7.

The results indicate a significant decline in soil moisture at each of the fields over the course of the study period. The overall trend of the drydown can be related to the topography, soils and vegetative cover of a sampling site. Upland, mid-slope, and areas of bare soil generally dried at a faster rate than floodplain areas and soils that were covered with heavy vegetation. This phenomena is evident. in Figure XV-3, Field 1, Transect 2. The sample site at the 150 m mark possessed bare soil on a slight incline. As the figure demonstrates, the soil dried out rather rapidly and to a relatively low level of water content. The next sample site however (at the 200 m distance), the soil moisture content was greater. This relatively flat sample site was situated on a terrace on the hill, and possessed tall dense grass with a high coverage density.

While the results of the data collection were consistent overall, one inconsistency is an increase in gravimetric soil moisture values reported on the last day (6/18) for Transect Fields 5,6, and 8. That is most likely due to a change in sampling technique on that day during which a much larger than normal sample was taken at each site. The collection of some samples in some fields was hindered by the presence of cattle and other miscellaneous reasons. Despite these minor setbacks, the acquisition of a majority of the field data was conducted without hindrance or incidence.

The overall quality of the data are judged to be good. The criteria for field selection and the sampling methodology selected suggest that the desired goals of this exercise may be attainable. These results combined with a detailed knowledge of the land cover, soil, slope characteristics, and other data collected during Washita '92 may yield provide interesting insights on the spatial and temporal relationships that soil moisture has on regional hydrology.

Table XV-I. Soil classification of fields in study area

Soil Association	Field Number 1	2	3	4	5	6	8
Cobb, 3-5% slope, fine sandy loam,			x				
Cobb, 3-5% slope, fine sandy loam, eroded	x	x	x			x	
Dougherty, 0-3% slope, fine sand							x
Eroded loamy land		x	x	x			
Eufala fine sand, rolling				x			
Konawa, 2-8% slope,, severely eroded	x			x	x	x	
Konawa, 3-5% slope, loamy **fine** sand	x				x		
Konawa, 3-5% slope, loamy fine sand, eroded		x		x			
Stephenville, 1-3% slope, fine sandy loam							x
Stephenville, 2-8% slope, fine sandy loam, severely eroded							x
Stephenville,-Eufala Complex, 3-8% slope,							x
Minco, 3-8% slope, loam			x				
Wet alluvial land					x	x	
Zavada, fine sandy loam			x	x			

Sources:	Soil Survey, Comanche County, Oklahoma. 1967.

Soil Survey of Grady County, Oklahoma. 1978.

Table XV-2. Vegetation cover of fields in study area.

Field	Location	Vegetafion/Landcover
I	Upland	Tall sparse grass, 24 inches, with thatch layer.Some succulents and shrubs.
	Hillslope	Tall grass with a high coverage density
	Floodplain	Mixture of tall and short grasses, some bare soil.
2	Upland	Tall grass, >24 in., with thatch layer.
	Hillslope	Tall grass with some thatch
	Floodplain	Mixture of tall and short grasses with some thatch.
3	Lower Field	Short grass, < 12 in., with frequent bare soil.Greater coverage density at the eastern end of the field.
	Upper Field	Mainly tall grass, =24 in., at the western end of the **field.** A mixture of tall and short grass in the eastern portion with less dense coverage. Active pasture.
4	Lower Field	Short grass, < 12 in., with some bare soil on the west bank of the creek. East bank has denser coverage and some shrubs. Active pasture.
	Upper Field	West bank has short closely cropped grass with some bare soil. East bank lower field has short grass with some bare soil. Active pasture. East bank upper field has tall grass, > 18 in., and a thick love grass mat covering the surface.
5	Upland	Short grass, < 12 in., active pasture.
	Hillslope	Active pasture with medium grass, 12 to 24 in.
	Floodplain	Tall dense vegetation in saturated soil.
6	Upland	Mixture of tall and short grass with patches of love grass and some bare soil.
	Hillslope	Patchy clumped love grass on ter-raced landscape. Thick thatch, I to 6 inches.
	Floodplain	Tall grass with some shrubs. Good coverage density. Wet soil.
8	Hillslope	Predominantly bare soil with some sparse plants (<5% cover).

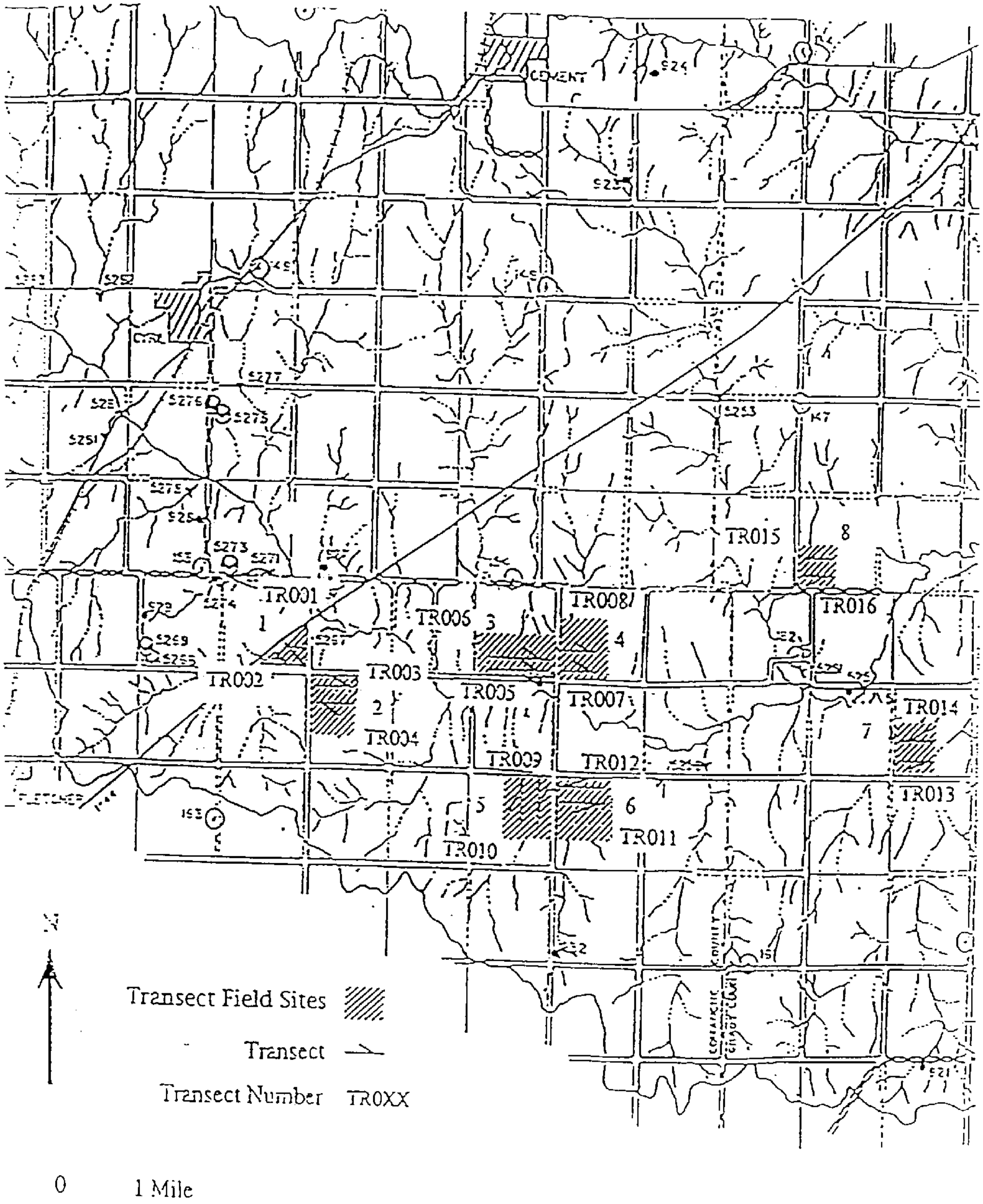


Figure XV-1. Map showing locations of transect sites.

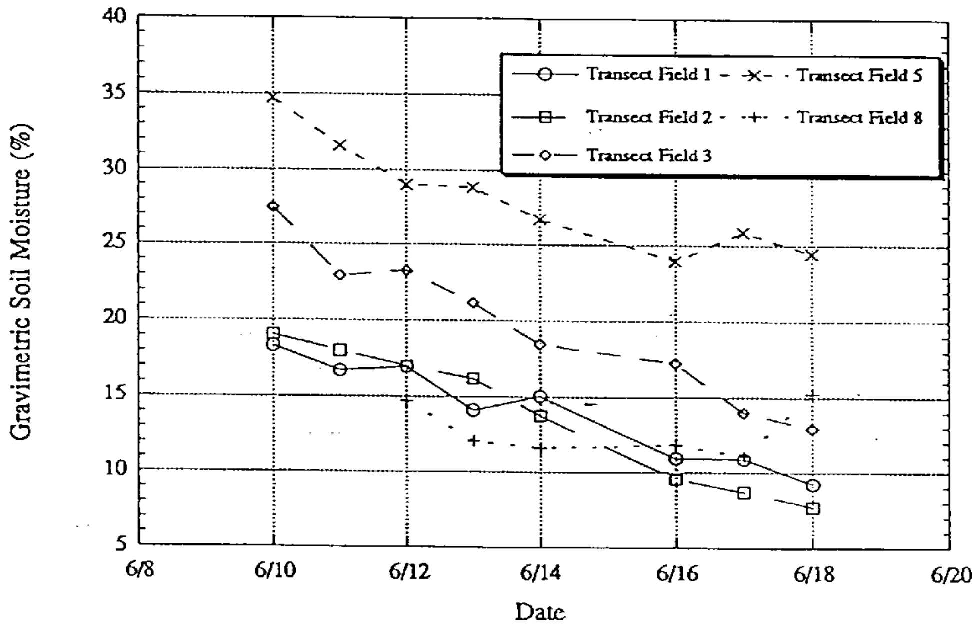
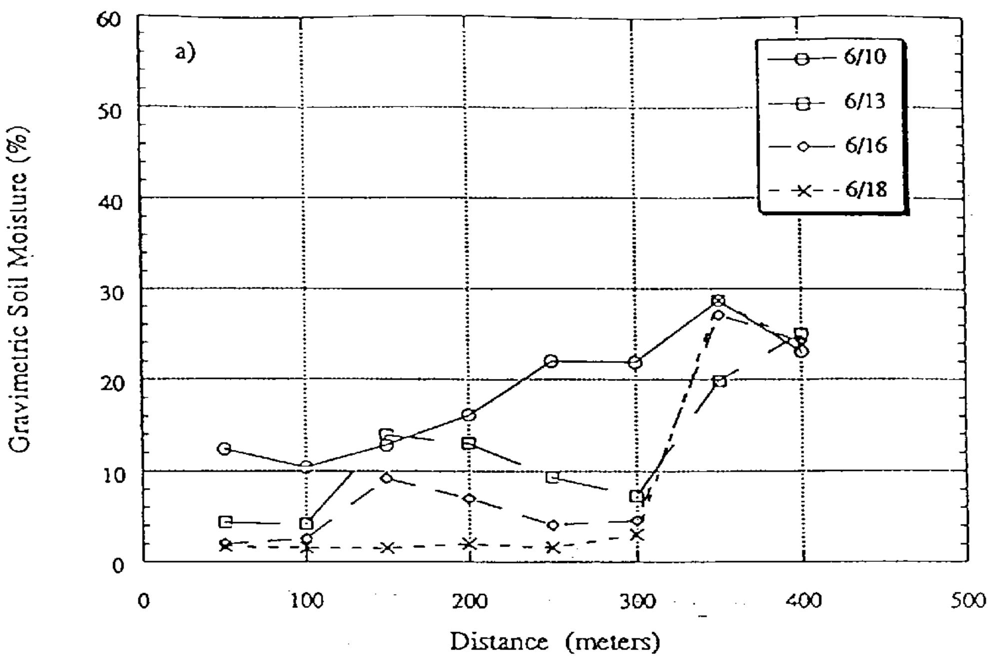


Figure XV-2. Average sample gravimetric soil moisture of each field



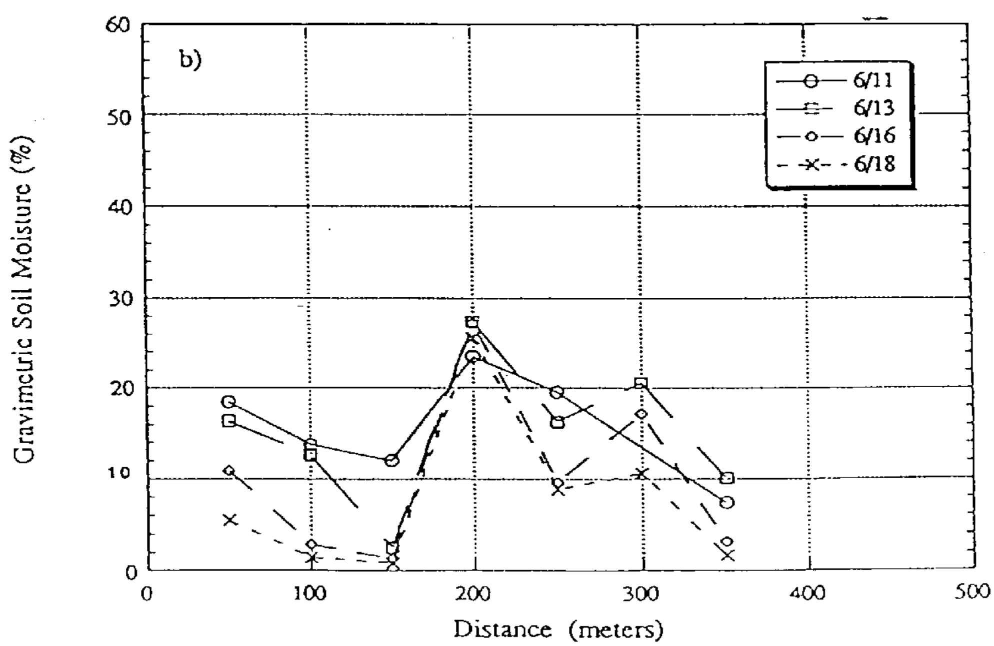
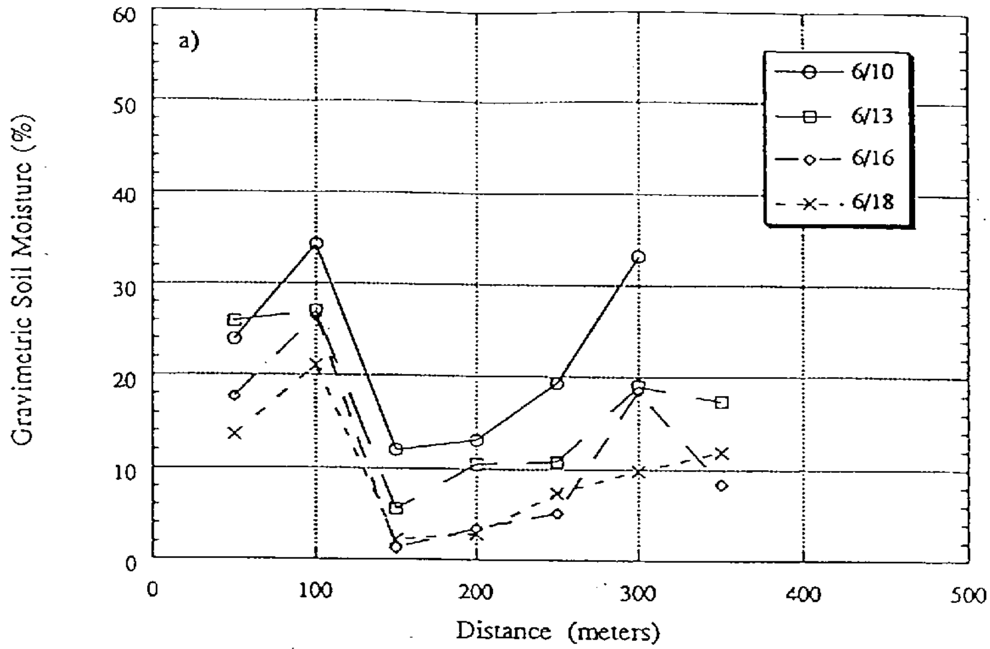


Figure XV-3. Gravimetric Soil Moisture for Transect Field 1
a) Transect 1, b) Transect 2



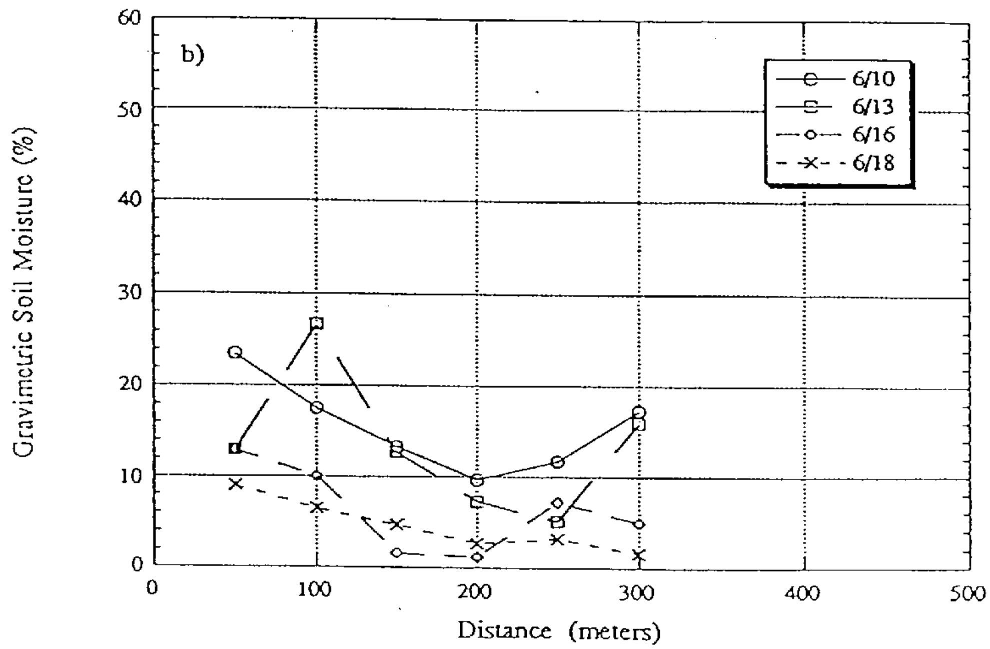
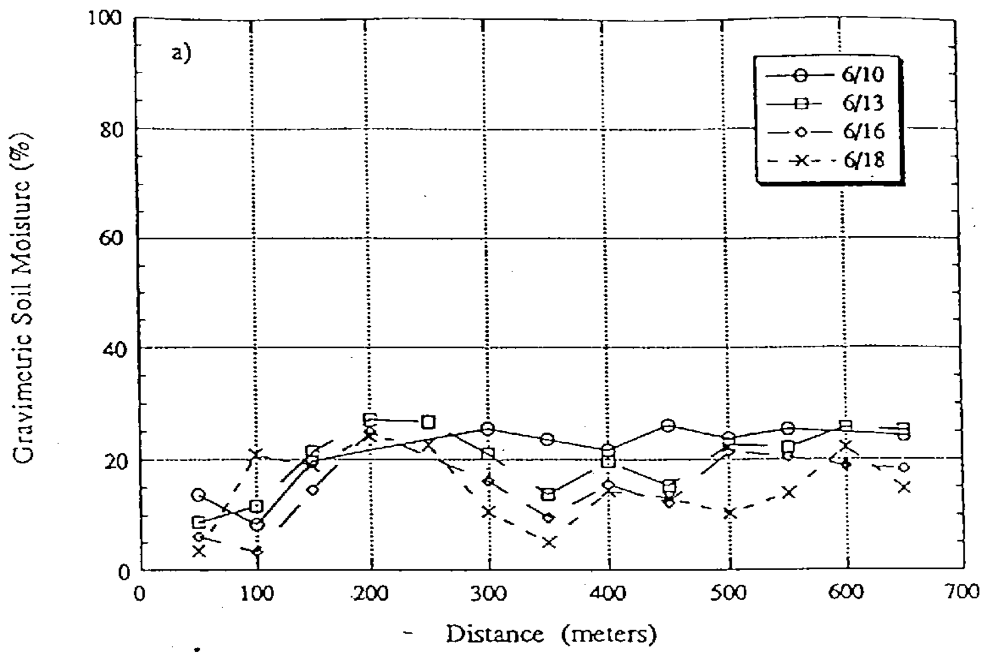


Figure XV-4. Gravimetric Soil Moisture for Transect Field 2
a) Transect 3, b) Transect 4



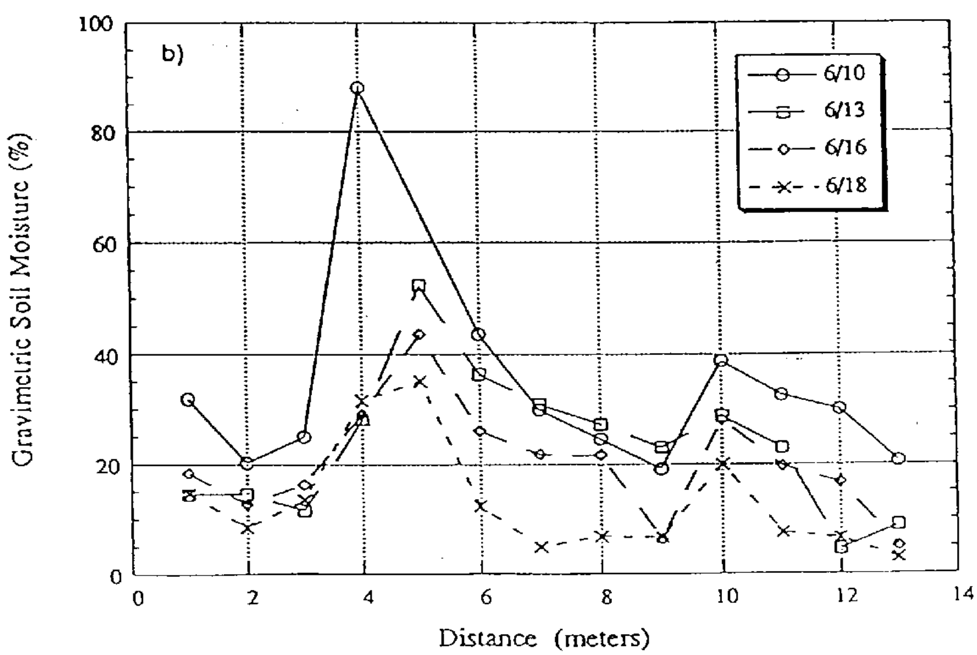


Figure XV-5. Gravimetric Soil Moisture for Transect Field 3
a) Transect 5, b) Transect 6

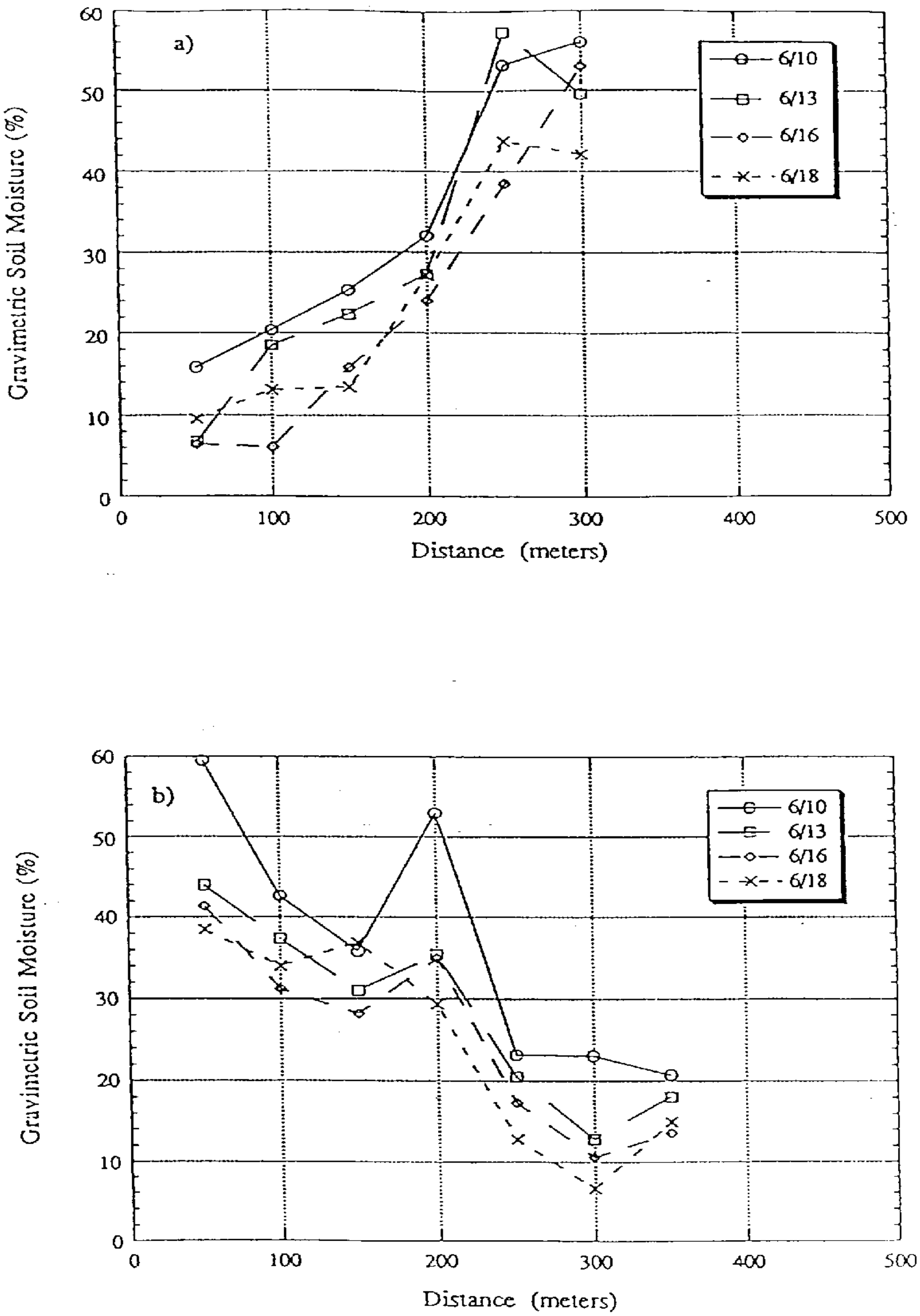


Figure XV-6. Gravimetric Soil Moisture for Transect Field 5
a) Transect 9, b) Transect 10

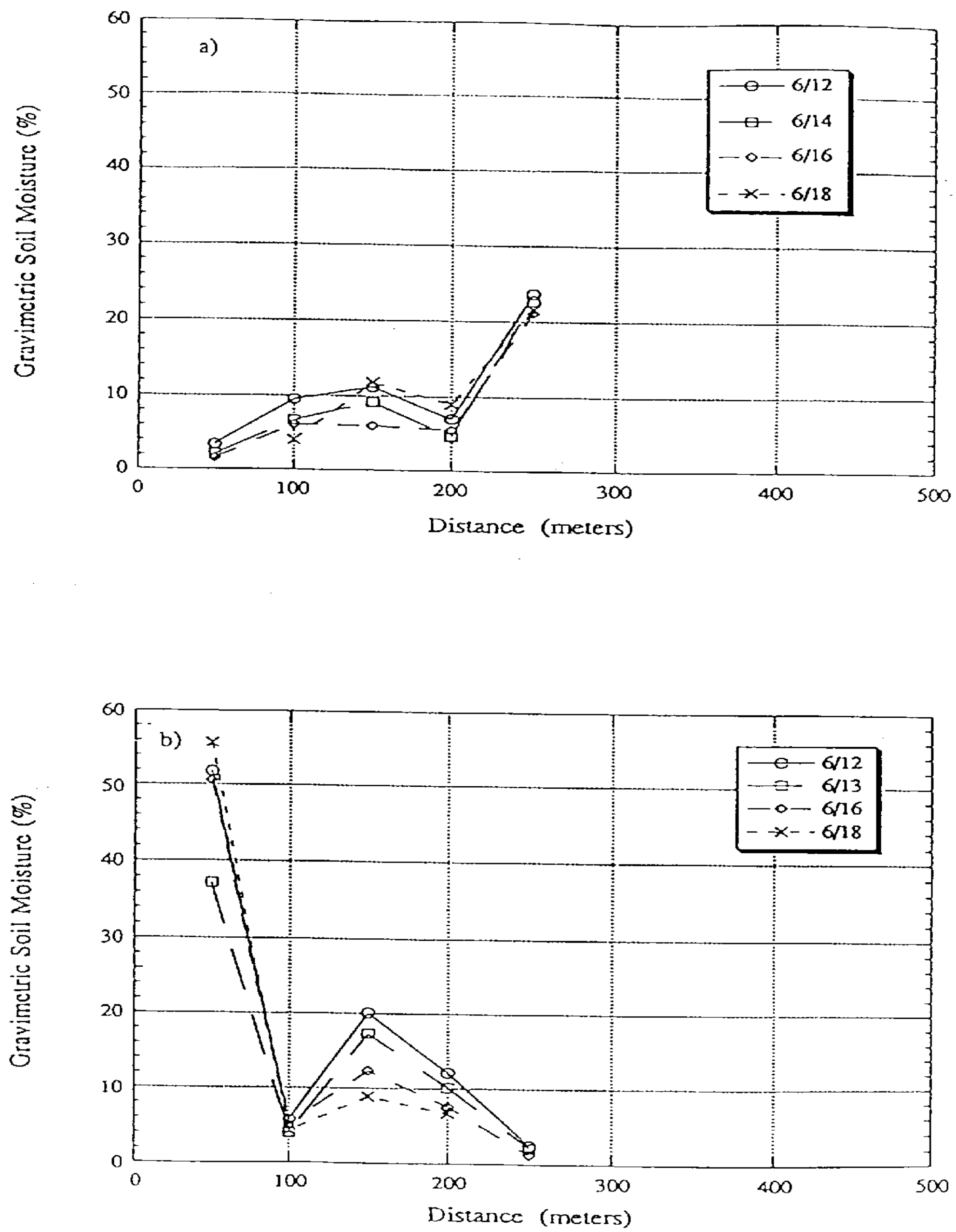


Figure XV-7. Gravimetric Soil Moisture for Transect Field 8
a) Transect 15, b) Transect 16