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Seasonal Use of Soil Moisture by Larrea Tridentata and Ambrosia Deltoidea

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SEASONAL USE OF SOIL MOISTURE BY *LARREA TRIDENTATA* AND *AMBROSIA DELTOIDEA*

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ABSTRACT

This project involves measuring soil moisture with a neutron probe at four locations near creosotebush (*Larrea tridentata*) and bursage (*Ambrosia deltoidea*) plants (four replications of each) and in adjacent isolation plots (Location 5) from which all shrub roots are excluded. The four access tube locations near plants sample four root competition-concentration situations, which will provide a measure of the influence of differences in shrub density on soil moisture use. Measurements are taken at two-week intervals and at 25-cm depth intervals, starting at 25 cm, to 2 m for creosotebush and 1.5 m for bursage. The study sites are on the Silverbell Validation Site (Tucson Basin, Arizona). Data for the summer growing season (June 7 to September 14, 1974) show that because of low rainfall (only one significant rainy period, 120 mm in 20 days in July) additions to soil moisture were largely limited to the 25- and 50-cm depths. The data also show that for this single incomplete recharge-loss event, there were no differences in either recharge or loss among the five measurement locations, for either creosotebush or bursage.

INTRODUCTION

This project was originally funded in January 1974. The study involves the measurement of soil moisture with a neutron probe at several locations adjacent to *Larrea tridentata* (creosotebush) and *Ambrosia deltoidea* (bursage) plants. During the first five months of the calendar year, work consisted of selection of the study area and establishment of access tubes. Soil moisture measurements have been taken at 2-week intervals since June 7. This progress report will summarize data for the summer growing season, June 7 to September 14.

OBJECTIVE

The objective of this study is to determine the annual pattern of soil water use and recharge within established stands of creosotebush and bursage.

METHODS

The study area is located in the northwest quarter of the Silverbell Validation Site. The soil on the area is Tres Hermanos fine gravelly-sandy loam. The sampling scheme is based on the premise that there is a functional relationship between the density and distribution pattern of plants and soil moisture changes. The access tubes for neutron measurement of soil moisture, therefore, are located in such a way as to sample a range of plant distributions, as follows (Fig. 1):

Location 1, on crown perimeter where crown of adjacent plant touches (zone of maximum root competition-concentration).
Location 2, on crown perimeter facing adjacent plant whose crown edge is 2 m away (1 m for bursage).
Location 3, on crown perimeter facing 4-m minimum opening (2 m for bursage).
Location 4, in opening, 2 m from study plant crown, and with no other plant closer than 2 m (1 m for bursage).
Location 5, in "bare" area, isolated from all shrub roots by trenching and wrapping with two thicknesses of 6-mil polyethylene plastic to 1 m deep.

For creosotebush, tubes in the first four locations are keyed to four individual study plants (replications), and four "Location 5" tubes are in an adjacent isolation plot. For bursage, the four replications of the first four tube locations are keyed to nine plants, because individual plants meeting all four location specifications were not available. Again, four "Location 5" tubes are in an adjacent isolation plot.

The 20 holes at the creosotebush site are 2 m deep, and those at the bursage site 1.5 m deep. Soil moisture readings (Vol. %) are taken at 25-cm intervals, starting at 25 cm, at both sites.

Stage (or stages) of development of each of the four study plants (Location 1 plants at bursage site) is recorded on each date of measurement as follows:

Symbol	Stage
0	Leaves mature
1	Leaf buds swelling
2	New leaves forming
3	Twigs elongating
4	Flower buds evident
5	Some flowers in anthesis
6	Plant in full flower
7	Fruits forming
8	Most fruits mature
9	Most fruits cast

Soil moisture and phenological data are recorded under DSCODE A3UC101.

RESULTS

Figures 2 and 3 show the pattern of change in soil moisture at the creosotebush (*Larrea*) and bursage (*Ambrosia*) sites, respectively, for depths of 25, 50 and 75 cm, for the period from June 7 to September 14. Rainfall during this period in 1974 totaled 124 mm, compared to 173 mm for the same period in 1972 and 39 mm in 1973. Over two-thirds of the 1974 total (85 mm) fell in a 20-day period in July. Thus, 1974 summer rainfall produced a single soil moisture recharge event, limited mostly to the upper 50 cm of the soil. Maximum increase in soil moisture was only 5 or 6% by volume, recorded at the 25-cm depth on August 1. At the 50-cm depth, the increase amounted to 2 to 3% at the bursage site and 1 to 1.5% at the creosote site. The 75-cm

depth showed increases of about 1% at the creosotebush site and 1.5% at the bursage site, reaching a peak on August 31, a month later than at the shallower depths. Below 75 cm, increases in soil moisture were generally less than 1% at the creosotebush site and slightly over 1% at the bursage site, reaching their peaks on August 31.

The phenological data show that creosotebush responded to the July rainfall by producing flowers by August 1, with leaf production, stem elongation and fruit formation starting during the following two weeks. Leaves and stems continued to grow during the remainder of the period. Bursage, on the other hand, made no growth response until August 15, when new leaves began forming and stems elongating. Leaf formation continued during the following month, but bursage did not flower.

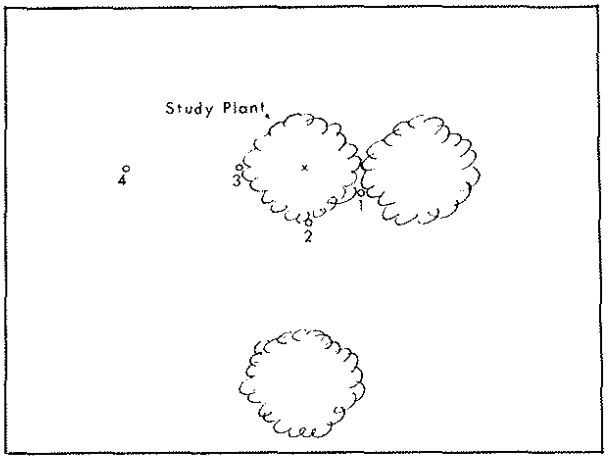

Figure 1. Location of access tubes near study plants.

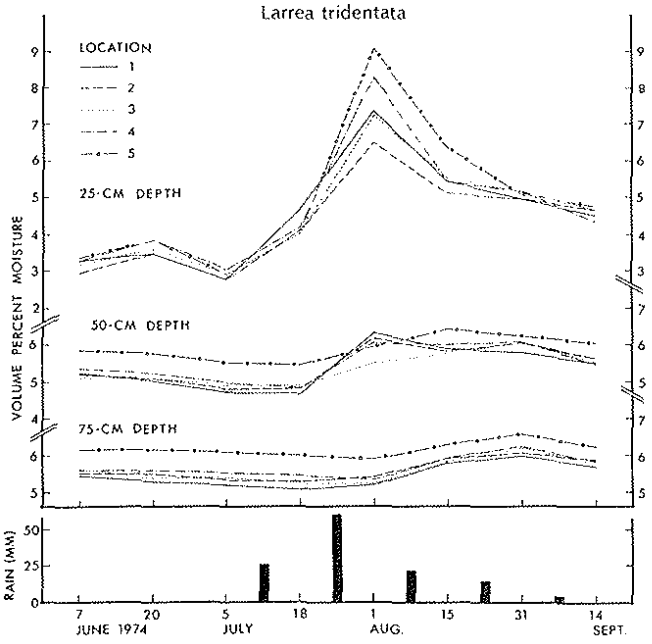

Figure 2. Volume percent moisture at 25-, 50- and 75-cm depths at four locations near *Larrea tridentata* (creosotebush) plants and in an adjacent isolation plot (Location 5) between June 7 and September 14, 1974 (DSCODE A3UC101); rainfall is for periods between dates of soil moisture measurement.

DISCUSSION

It is readily apparent from Figures 2 and 3 that changes in soil moisture were similar for all five tube locations for both species during this period. This indicates that for this single instance of partial wetting of the upper layers of the soil, rates of wetting and of subsequent soil moisture loss were not appreciably affected by the presence, absence or nearness of plants of either species to the point of soil moisture measurement. This conclusion regarding this single incomplete recharge-loss event cannot, of course, be considered as representative of the true relationship during more normal periods of recharge and moisture use.

The extreme dryness of the first six months of 1974 (16 mm in January, 16 mm in March and no rainfall between March 18 and July 7) and the obvious stressed appearance of the shrub foliage, particularly that of bursage, in early June, indicated that soil moisture was undoubtedly at the wilting point at the start of the record period. Because of

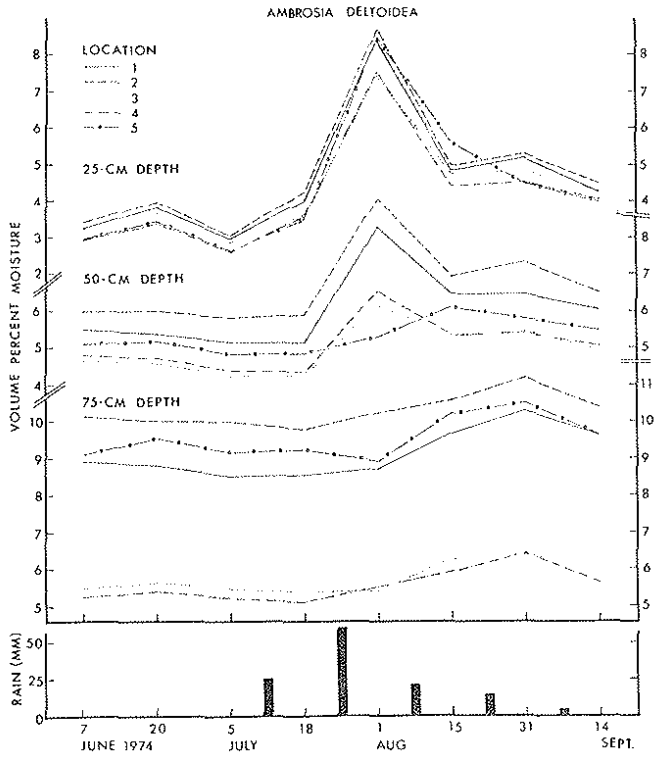

Figure 3. Volume percent moisture at 25-, 50- and 75-cm depths at four locations near *Ambrosia deltoidea* (bursage) plants and in an adjacent isolation plot (Location 5) between June 7 and September 14, 1974 (DSCODE A3UC101); rainfall is for periods between dates of soil moisture measurement.

this, an inference concerning soil moisture texture can be drawn from the differences in levels of soil moisture values. For example, at the creosotebush site, the moisture values for the five locations cluster closely together, particularly when the soil is dry, indicating little difference in soil texture. The higher level at 50- and 75-cm depths (5 to 6% on June 7, compared to about 3% at 25 cm) indicates somewhat finer texture at these depths. Increasing soil moisture values to 2 m (8.7% on June 7) indicate increasing amounts of clay with increasing depth. At depths below 50 cm at the bursage site, the clay content is apparently much higher than at the creosotebush site. This is indicated by the much higher moisture content at three of the five locations at 75 cm (Fig. 3), and at all locations from 1 m down (to 10.7% at 1.5 m on June 7).

EXPECTATIONS

If this project is approved to continue through calendar year 1975, soil moisture measurements will be taken at 2-week intervals. Normal or above-normal rainfall during 1975 will provide a more positive picture of the relationship of shrub density to soil water extraction.