A STUDY OF WATER USED ON URBAN LANDSCAPES

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Abstract

A study conducted to determine the water used by urban home owners in Las Cruces, New Mexico, to maintain their landscapes showed that from 40 to 65 percent of private metered water was used for maintaining plants in the landscape. The water quantity used was in proportion to living mesic plants. Homeowners with 90 to 100 percent of the space devoted to living plants applied 99 percent more water per home than landscapes characterized as intermediate, where living plants were maintained on only 50 to 70 percent of the space. A highly significant correlation coefficient of 0.738 was obtained between landscape water use and landscape size. However, approximately 38 percent of the average amount of water utilized for landscape irrigation is in excess of estimated optimum amounts. Renewed emphasis on education programs directed toward an attempt to encourage wise water usage is urgently needed.

Introduction

The universal importance of water for all plant and animal life forms creates many problems and complicates its optimal utilization in modern society. Formerly, Man tended to settle only where water was naturally available to sustain his basic household and agricultural needs. Now, Man has diffused into areas lacking in water. Demands of an exploding population are so numerous and so great that water problems are becoming more acute each year. Studies on how urban man uses water are urgently needed.

Water is used to maintain scenic, recreational, and aesthetic resources. Paramount amount those resources requiring water is urban-residential landscaping. Current and near future shortages of quality water available for application to urban landscapes is becoming a critical problem. It is essen-

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tial that a better understanding of the actual water requirements of landscape plants be obtained.

Review of Literature

Value of the urban landscape as a source of avocational creativity and emotional satisfaction is real. Secretary of Agriculture Earl L. Butz[1] quotes a survey in which 59 percent of those surveyed checked "green grass and trees around me" as an item (of 26 offered) which they considered most important to their happiness. He goes on to say "....greenery and flowers satisfy some psychological need in people..."

Lanphear[2] outlines the value of plants in the urban landscape in the following five categories: 1) noise abatement, 2) natural filters for gaseous and particulate aerial pollutants, 3) biological monitors where plants serve as indicators of critical levels of aerial pollutants, 4) temperature modification where plants serve as natural air conditioners, 5) other effects such as glare reduction and visual screening of unattractive areas.

Cooke and Van Haverbeke[3] have quantified noise abatement potential of trees and shrubs. Foliage commonly results in reductions of 5 to 8 decibels, and reductions up to 10 and 15 decibels were noted in their study. While shrub placement in relation to noise source was important, species differences in noise abatement were not high.

Water use in landscape maintenance is important, not only in the amount utilized, but also in its rate of utilization. Clark and his co-workers[4] reviewed data from a study conducted in Baltimore, Maryland, which showed the mean annual sprinkling load was 30 percent of the total water used in a residence. However, during peak hourly consumption periods (normally 5:00 - 9:00 p.m.) the sprinkler load accounted for as much as 95 percent of total usage.

Little is known about landscape plants' water requirements. While they are predominantly mesic, and water requirements can be considered physiologically similar to irrigated, monocultured, crop plants, the circumstances under which they are grown and criteria for excellence differ. Interaction between plant specimens and inanimate landscaping materials such as decorative rocks, gravel mulches, or concrete has not been investigated.

The best information available is from research conducted on turf in monoculture. Tovey[5] found 20 acre-inches was required annually to maintain Burmuda turf in Nevada. Erie, et. al.[6] report that over a period of five seasons an average of 43.5 acre-inches was required for Bermuda turf in Mesa, Arizona. Turf grass water requirements were estimated to be 41.8 acre-inches for El Paso, Texas[7]. There is virtually no information on the water requirements of trees and shrubs commonly used in the landscape in either specimen or massive planting settings.

Thus, a paradox exists between the value of plants in Man's environment and the water resources expended to maintain them. This study was conducted to shed some light in this unexplored area as follows:

1) To compare total use and peak monthly periods of water used on landscapes of urban dwellers in Las Cruces, New Mexico.

2) To survey these homeowners about their knowledge concerning the amount of water they applied in relation to knowledge of plant water needs.

Procedures

A preliminary study using 10 residences was conducted to serve as a guide for establishing procedures on the subsequent test. Homes in various locations were selected. Data on the total metered water used by each residence was obtained from City of Las Cruces utility records, and surface area of each site devoted to plant material under formal landscaping was measured. Each home owner was interviewed about landscape age, watering practices, and other features which might account for large water consumption rates other than those necessary to maintain basic household requirements.

Forty-three residences were evaluated during spring, 1972. These were similar in lot size, located on the east mesa of Las Cruces, New Mexico, and possessed a similar sandy soil. Each depended entirely upon metered municipal water. Homes exhibiting drastic fluctuations in monthly water use were omitted. Landscapes with swimming pools, ponds, or other unusual water use were also excluded. Home owner permission to survey the landscape was obtained in both the preliminary and main study.

According to degree of plant materials, the landscapes were placed in one of three categories: GREEN, INTERMEDIATE, and DESERT. Only the area devoted to plants was measured. Sidewalks, driveways, gravel, and bare areas not supporting plants were omitted.

GREEN landscapes were characterized as having lawns or other mesophytic plants covering 90 to 100 percent of the possible landscape area.

INTERMEDIATE landscapes were characterized as having lawns or other mesophytic plants covering 50 to 70 percent of the possible landscape area.

DESERT landscapes were characterized as having native or other xerophytic plant materials covering not more than 20 percent of the possible landscape area.

Estimates of 1971 water use for each residence were made from City of Las Cruces metered water records. A base monthly household use rate was computed and subtracted from each monthly use. Base monthly use rates were computed by averaging the two lowest monthly water uses, usually December and January.

Results

Total water quantity applied varied in accordance to the landscape category. Annual water use for GREEN landscapes (20 residences) was 203,000 gallons, to 102,000 gallons for those in the INTERMEDIATE category (20 residences), and 36,000 gallons for the three residences in the DESERT category. These quantities were 65.5 percent, 49.6 percent, and 40.0 percent of the total metered water, respectively.

Peak monthly use period varied substantially from residence to residence through the irrigation year. Of the 43 homes surveyed, 1 reached its monthly peak in April, 2 in May, 18 in June, 18 in July, and 4 in August. Water use peaks and patterns are illustrated in Figure 1 for three residences having similar water usage in the GREEN category. Landscape A rises sharply to a peak in April and crops rather uniformly through the remaining months. Water use in Landscape B rises more slowly, peaking in June, and dropping to October. Usage in Landscape C rises slowly to an abrupt peak in August followed by a rapid decline.

A relationship of water use by residences A, B, and C compared with open pan evaporation rate is depicted in Figure 2. Maximum, nearly equal open pan evaporation amounts occurred in May, June, and July, totalling between 13-14 inches per month. If water is available, evapotranspiration of a crop plant-soil system is in reasonable proportion to the open pan evaporation rate[8]. Assuming landscape plant evapotranspiration is similar, one would predict peak usage to occur during May, June, and July. Such was not the case.

In a further attempt to explain the variation in monthly peak use patterns, Landscapes A, B, and C were plotted with the monthly rainfall (Figure 3). Since little rainfall was recorded, it could not have had a marked effect on the distribution of irrigation water. Even in July, when 1.77 inches of rainfall occurred, 18 residences recorded peak water consumption.

In a correlation analysis comparing water used in the landscape area, a correlation coefficient of 0.738 was obtained. While the relationship is highly significant, almost 50 percent of the associative variation was not accounted for by the analysis. The regression of water used on landscape size is depicted in Figure 4.

The mean water applied all to landscapes in this study was 58 inches per acre per year. Estimates of water required for turf in Las Cruces are sketchy. However, if one assumes that the usage of 43.5 inches reported for Mesa, Arizona[4] is a reasonably accurate estimate, and that approximately 1.5 inches of effective rainfall fell during the test period, then approximately 14 inches of water were applied unnecessarily to the landscapes under evaluation. The excess applied is more than 38 percent above optimal. Thus, for each three acres of residential landscape, another acre could be supported by simply reducing water application rates to the estimated yearly optimal amount.

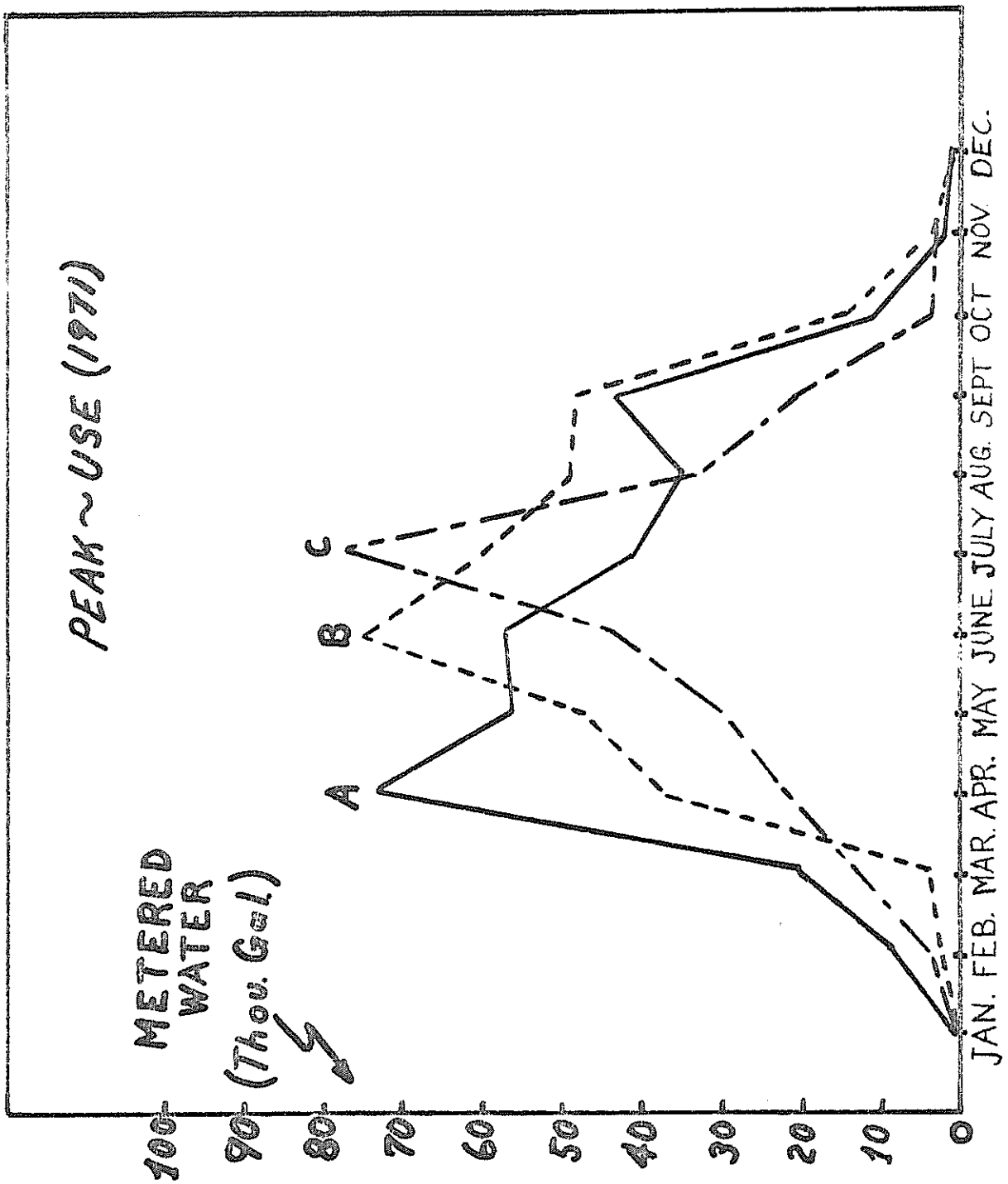

Figure 1. The 1971 monthly water consumption pattern for three urban residences used to maintain landscapes having 90 to 100 percent of available area devoted to mesic plants (green category).

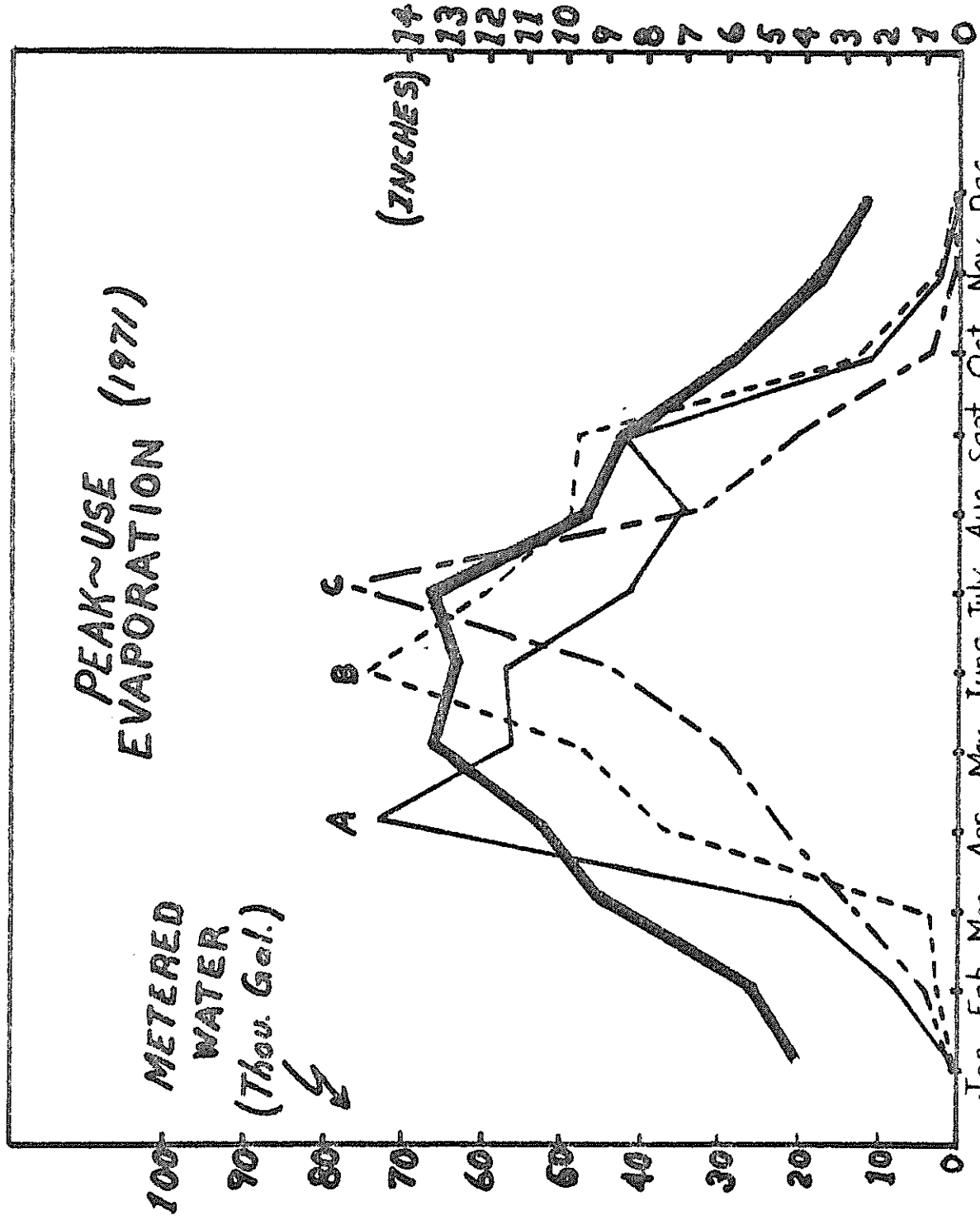

Figure 2. Monthly water consumption pattern used to maintain three green landscapes and open pan evaporation for 1971.

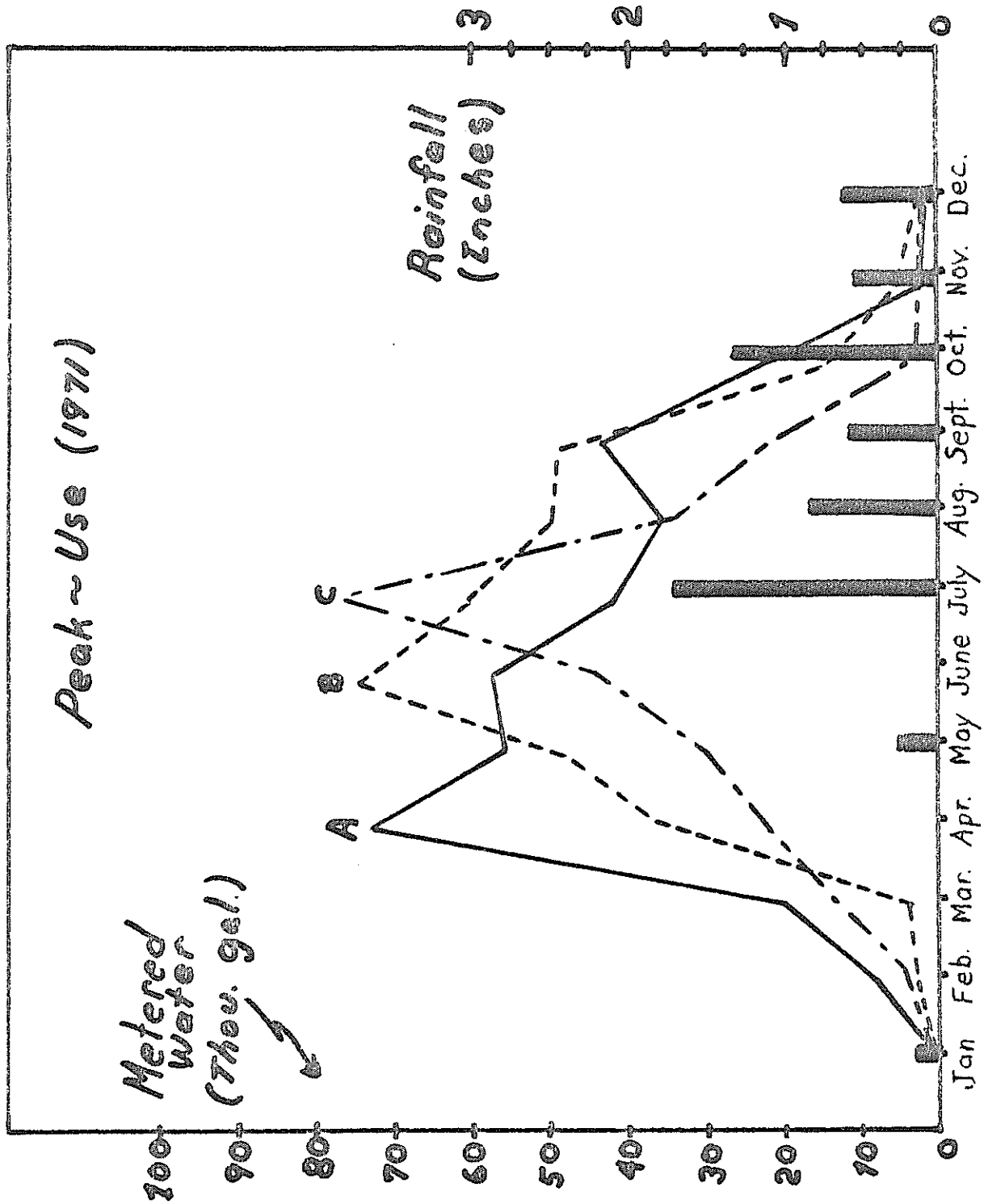

Figure 3. Monthly water consumption pattern used to maintain three green landscapes and rainfall for 1971.

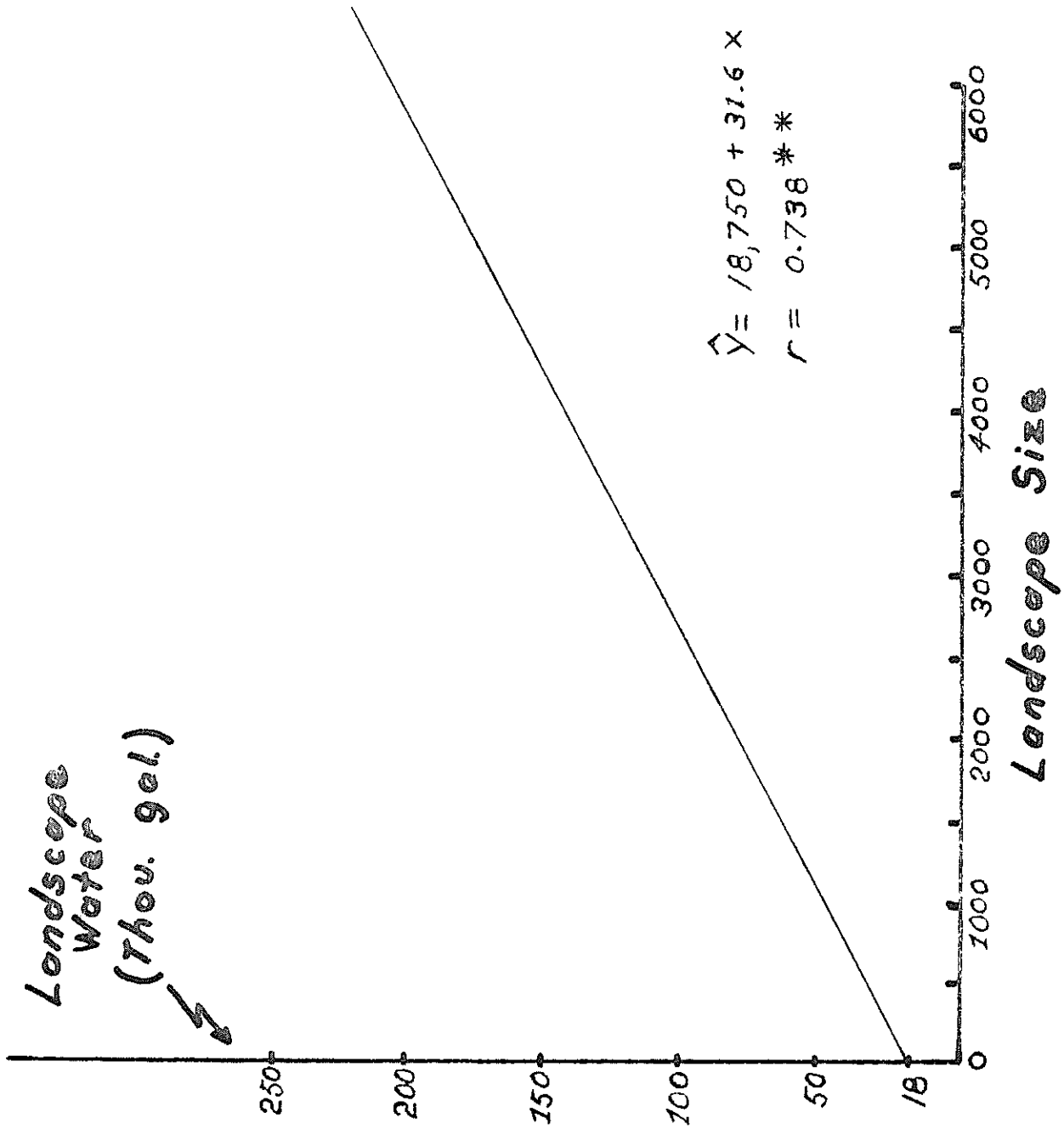

Figure 4. The regression of water use on landscape size for 43 urban residence located in Las Cruces, New Mexico for 1971.

The data above indicate that homeowners are not consistent in timing and quantity of water applied. Results from the home owner survey verify that urban residents need additional information about their landscape needs. Forty-one of forty-three home owners were neither aware of their irrigation water use patterns, nor did they have a good idea of optimum quantities landscape plants require to maintain good growth.

Conclusions

From an interpretation of the 1971 data presented, the following conclusions appear warranted:

1) Less water is applied to residential landscapes as gravel, rock, and desert plants are incorporated into the landscape plan.

2) The patterns of water used to maintain landscapes do not occur in conjunction with open pan evaporation.

3) The mean total water used was approximately 38 percent in excess of the estimated optimum amount needed.

4) Emphasis on residential homeowner educational programs directed toward encouraging efficient water use appears warranted.

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