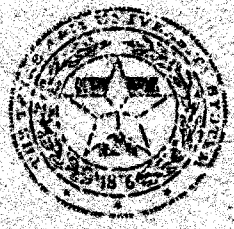
San Antonio

Evapo-Transpiration

Study Report

1999



Conducted by:

Texas Agricultural Extension Service/Bexar County
Bexar County Master Gardeners
The Texas A&M University System

For:

San Antonio Water System

SAN ANTONIO EVAPO-TRANSPIRATION (ET) PROJECT

MANAGEMENT, TRAINING AND ANALYSIS TEAM

Joe Taylor
Dee Emory

WEATHER STATION

Guy Fipps, Ph.D.

VOLUNTEER MONITORS

Russell Denison
Dee Emory
Olga Garcia
Carrie Hammer
Kim Kissinger-Ayala
Marian Machman
Al Mote
Loris Perkins
Diane & Larry Pfeil
Earl Putnam
Joe Taylor
Cleon Warren
Wilbur Watje

SAWS LIAISON

Dana Nichols, Conservation Planner II

SAN ANTONIO EVAPO-TRANSPIRATION (ET) STUDY

In the summers of 1997, 1998, and 1999 a partnership between the Texas Agricultural Extension Service and Bexar County Master Gardeners with funding from the San Antonio Water System conducted the San Antonio Area Evapo-Transpiration (ET) Study. The first year of the project determined that an ET program for home lawns was feasible. In 1998 the objective was to fine tune instructions and determine irrigation needed for various turf types. In 1999 the objective was to continue fine tuning the instructions and involve media outlets, such as newspaper and television. The Study also included irrigation needs of St. Augustine in shade as compared to St. Augustine in full sun.

Table of Contents:

EXECUTIVE SUMMARY

The San Antonio Evapo-Transpiration Study has completed three summers of intense, detailed work. The results of three years of work indicate several turfgrass irrigation needs that can be utilized along with Potential Evapo-Transpiration to save water in the San Antonio area.

Using data from the 1997 and 1998 studies, the ET Advisory Committee assigned percentage numbers to turfgrass types. In the 1999 study these recommended water rates were assigned to St. Augustine, Bermuda and Buffalo grasses and were tested. Also tested were irrigation needs for St. Augustine turfgrass located in the shade.

These recommendations were weekly water irrigation rates of one (1) inch for St. Augustine grass, three-fourths (¾) inch for Bermudagrass, one-half (½) inch for Buffalograss and three-fourths (¾) inch for St. Augustine grass in the shade. These recommendations would be considered 100% ET for St. Augustine, 75% ET for Bermudagrass, 50% ET for Buffalograss, and 75% ET for St. Augustine grass in the shade.

Zoysiagrass, because of varietal differences and limited lawn site participation, was recommended to be treated the same as St. Augustine grass in full sun and St. Augustine grass in the shade.

Evapo-transpiration (ET) is the amount of water that is lost to a plant through evaporation from the soil and transpiration from the leaf surface. Potential evapo-transpiration (PET) is an approximation of that water loss by applying a species specific factor to a formula that utilizes daily temperatures, relative humidity, wind, solar radiation and rain. In San Antonio the weather data is collected by a weather station which operated at the SAWS Jones-Maltsberger Turfgrass/Xeriscape Management Site. The Site is managed by the Texas Agricultural Extension Service/Bexar County Master Gardeners. ET is calculated by multiplying PET values by an empirically derived co-efficient.

In the summer of 1999, evapo-transpiration (ET) rates were recommended via the ET Hotline, the *San Antonio Express-News* and two television stations, KABB-TV (Channel 29) and KENS-TV (Channel 5).

After evaluating the 1997, 1998 and 1999 results, it has been recommended that a major ET initiative be launched in the summer of 2000.

RECOMMENDATIONS FOR 2000

Introduction

ET Studies for the past three summer periods in Bexar County conclude that utilizing an area-wide ET Program will save a considerable amount of water in turfgrass and landscape water.

Utilizing mass media to promote the use of ET is essential. Television, radio and newspaper can provide ET data and recommended irrigation rates every day. (The data can be offered every day for the last seven (7) day accumulation period.) Reports can give precise irrigation rates and homeowners could even keep personal watering logs and compare to last summer's water use to determine if they are actually saving water.

Homeowners would be enlisted at all SAWS and Master Gardener events. Instructors would hold special ET days all around San Antonio to enlist participants and volunteer ET instructors could be trained and used in every neighborhood in the city.

The ET information could also be published daily on a Web page for those with Internet access.

Studies using evapo-transpiration should continue in the 2000 calendar year. It would be useful to have more data on turfgrass performance in shade situations and the effects of dividing irrigation into two (2) applications per week for turfgrass in shallow soils.

Once again in 2000, the ET Study would recommend (1) homeowners with St. Augustine grass or Zoysiagrass in the sun to irrigate at the 100% of ET rate and those homeowners with these same turf varieties in the shade to water at 0.75 of ET; (2) homeowners with Bermudagrass would be encouraged to water at 0.75 of ET; and (3) those with Buffalograss water at 0.50 of ET. The program, in the year 2000, would recommend that homeowners water only once a week to abide by water conservation guidelines.

It is recommended that the program continue to provide ET Watering Kits to participants and to once again launch a very aggressive educational program through the media and community outreach.

The utilization of media weather persons would be extremely important to the success of an area-wide program. The estimated cost of the program for 200,000 would be $69,600.

The program would be operated by SAWS or subcontracted. The Texas Agricultural Extension Service and the Bexar County Master Gardeners would be very interested in operating the ET Program or a contractor could be selected by a RFP.

ET Lawn Kits

We have over 2,500 available kits to launch right into the 2000 ET Program. The ET kits consist of the following:

1 plastic rain gauge
4 sprinkler rate catch pans (with measuring scale inside)
ET Definition and "How it Works" information sheet
Sprinkler Rate Testing Instructions
Personal Lawn Worksheets
Chart to assist and record water savings

The kits are available at the Bexar County Master Gardeners Office, the Bexar County Extension Office and the SAWS Service Centers.

Media Orientation

1. Promote ET and ET Lawn Kit dispersals at SAWS Jazz Festival and Lawn and Turfgrass Festival in May
2. Assemble a speakers bureau
3. Continue ET Hotline
4. Continue newspaper promotion
5. Continue television promotion with weather broadcasters

Estimated Water Savings

If this Program was implemented, the estimated water savings would be 630 million gallons per year. The estimate was based upon 25,000 homes with 1/8 acre of turfgrass, using 24 inches of irrigation now reducing to 16 inches with ET. Eight inches of water over 3,125 acres equals 2,093 acre feet of water per year. Two thousand, ninety-three acre feet equals approximately 630 million gallons per year.

Campaign Activities

Information at Public Events

- SAWS Jazz Festival at San Antonio Botanical Gardens
- Lawn and Turfgrass Festival at Jones-Maltsberger Turf Management Site
- Bexar County Master Gardener Training Sessions (2 per year)
- Texas AgriFood Master Training Sessions (2 per year)
- Special neighborhood events
- Requests from surrounding counties for presentations
- Viva Botanica!
- Fall Garden Fair
- Turf Days at Jones Maltsberger Turf Management Site (monthly, May-October)

Media Campaign

- Morning shows
- Newspaper columns
  - *San Antonio Gardener*
  - *Scion*
  - *Horti-Bull*
  - *San Antonio Express-News*
  - *Recorder Times*
  - *Southside Reporter*
  - *North San Antonio Times*
  - *Senior Sentinel*
  - *Texas Nurserymen and Landscape Architects Newsletter*
- Radio garden shows
- SAWS monthly statements
- Weather shows

ET Information Website

- Questions and answers via e-mail

Budget for 2000 (12 MONTHS)

Item	Annual Amount Needed
ET Coordinator Program and Administrative Services	$26,700
Operation and Maintenance of ET Equipment Weather station components, computers, monitors and Website, including annual calibration and emergency backup equipment	$24,000
Speakers Bureau Train 6 volunteers to speak about ET and assist with distribution of ET Water Kits at sites	$ 6,900
Texas A&M Weather Information Support	$12,000
TOTAL	**$69,600**

Recommended Time Line for 2000

ET Team and Advisory Board (discuss and revise)	January, 2000
Complete Final Report	May, 2000
Present Report and Recommendations to SAWS Board	May, 2000
Begin 2000 ET Promotions	May, 2000
Begin Media Efforts	May, 2000
Media Luncheon	June, 2000
ET Interactive Website	June, 2000
Evaluate 2000 Program	November, 2000

DEFINITIONS

Potential evapo-transpiration (PET) is defined as the potential water use from a hypothetical cool-season grass growing four inches tall under well-watered conditions. PET is used as a "reference" to which a particular turfgrass species is compared mathematically.

PET values can be calculated using several empirical methods developed through research. For the ET Study, the "Penman-Monteith" methods is used. Several organizations, such as the International Committee of Irrigation and Drainage and the Water Requirements Committee of the American Society of Civil Engineers, have proposed establishing the Penman-Monteith method as a world-wide standard. In this method, PET is calculated on a daily basis according to weather input parameters which are collected with automatic weather stations. Input data includes wind speed, relative humidity, temperature and solar radiation. Thus, PET rates will differ from location to location, according to climate.

Texas ET Network and Website

Daily weather information is collected from an automated weather station located at the Jones-Maltsberger demonstration site in San Antonio. Data is downloaded via telephone/modem connection to the Texas ET Network Center at the Agricultural Engineering Department at Texas A&M University in College Station. Data is then fed into a program to calculate PET. PET values are immediately reported on the Texas ET Network website at *http://texaset.tamu.edu* and becomes accessible for use in irrigation scheduling.

Application

PET is an important tool for predicting water lost to specific plants through *evaporation* of water from the plant surface and the water lost to *transpiration* through the plant, or **evapo-transpiration (ET)**. To obtain the ET for specific plants, the PET value is multiplies by a turf (or crop) co-efficient (T_C), which represents the percentage of PET that a specific turfgrass will use. For example, a turf co-efficient of 0.6 represents warm-season grasses, such as St. Augustine, Bermuda, Buffalo and Zoysia. A turf co-efficient of 0.8 is used for cool-season grasses, such a Tall fescue.

Example: PET = 0.25 inches of water per day
$T_C = 0.6$
Water Use (or ET) = 0.25 x 0.6 or **0.15 inches of water**

Differences in growth characteristics and drought response among warm-season grasses are visible. Buffalo, for example, exhibits a higher drought tolerance than St. Augustine. For this reason, an allowable stress factor must be included as part of the equation quality and appearance. This project studies allowable stress values of 100%, 70% and 50% for each of the four warm-season grasses above, while at the same time, measuring the quality and appearance of the turf using a rating scale.

Soil Depth

Soil depth is the average soil depth in lawn turfgrass sites. ET monitors measured soil depth in three areas of each turfgrass site. The soil depth was then averaged to come up with the mean soil depth of each participating lawn site.

METHODS AND MATERIALS

The Evapo-Transpiration (ET) pilot study began in 1997 and a follow-up study continued in 1998. Volunteers from the Bexar County area monitored turfgrass quality and followed a weekly watering schedule determined by Evapo-Transpiration or "ET". Homeowners watered on Monday evening or Tuesday morning.

Potential Evapo-Transpiration and weather summary data is collected by an automated weather station located at the corner of Jones-Maltsberger and Loop 410 North. The weather station data collection includes the date, the maximum temperature, minimum temperature, relative humidity, solar radiation, average wind speed and rainfall. This information is transmitted to Texas A&M University where the information is analyzed. The PET (Potential ET) is calculated and the crop co-efficient is applied to produce the Evapo-Transpiration (ET) in inches per day. This information is recorded and updated on a daily basis and available on the Web at *http://texaset.tamu.edu*.

In 1998 homeowners for the Bexar County ET Project were recruited in several ways. Those experimenters who were punctual and accurate in providing data in 1997 were invited to participate again in 1998. Additional individuals were recruited by soliciting volunteers through messages in CEA Finch's articles in the *San Antonio Express-News, Southside Reporter, Northside Recorder, North San Antonio Times, San Antonio Gardener,* and *The Scion*. He also announced the need for experimenters on his KLUP Radio program. Other experimenters were recruited through solicitations at Master Gardener training classes.

The goal was to have a volunteer monitor for every five experimenters. The monitors for 1998 were Master Gardeners and lawn experimenters from 1997. Potential monitors were recruited in *The Scion* newsletter (Bexar County Master Gardeners). Other candidates were directly recruited by ET staff members.

A team of ET staff members and a monitor in the prospective candidate's neighborhood visited the lawn to determine its suitability. Lawns in full fun with at least 4 inches of soil and rated at least a 2 were sought. The choice was further defined by trying to select 9 St. Augustine lawns, 3 Bermuda, 3 Buffalo and 3 Zoysia in each of the four quadrants.

Homeowners elected had to sign an agreement (copy in appendix) that outlined their responsibilities. They also had to agree to attend one of 2 training sessions scheduled for their benefit. The training session covered how to measure irrigation output, the goals of the experiment, introduction to their monitor, how to complete required paperwork, how to obtain the weekly ET information over the phone and the required lawn cultural practices. Each participants received an instruction manual (appendix).

The team determined soil depth by applying a soil probe in three locations and then using a plastic rules to measure soil depth. The locations to probe were selected in the center and to the east and west portion of the test area.

Experimenters rated their lawns every week and submitted the information to the monitor every month. Ratings were conducted from 05/14/98 through 11/16/98. If the data appeared inaccurate (wildly fluctuating, etc.) or was late, it was the volunteer monitor's job to confer with the homeowner.

The monitors were also responsible for collecting the data from moisture meters placed in their lawns (5 total meters).

The environmental coordinator collected the date from the monitors. It was her job to again examine the data provided and send the monitor back to the experimenter if there were questions.

Late in the experiment (November), members of the staff team and monitors collected soil samples to determine bulk density. A 91.44 cm soil probe was used to collect a cu. cm sample from the center of the turf area. The sample was sent to Texas A&M where it was dried at 120°C. and weighed. The weight was then divided by volume (5.98 cu.cm) to determine bulk density.

Lawn ratings were graphed. Ratings by turf variety and watering regime, moisture meter readings and ET values were graphed.

On July 6, Stage 3 drought restrictions were implemented, forcing experimenters to water according to guidelines under the restriction. The restrictions took away the flexibility for experimenters to water on Monday or Tuesday and required watering on Tuesday or Thursday, depending on whether experimenters has an odd or even address. ET data was offered on Monday and Wednesday after restrictions were imposed.

The ET Advisory Committee consisted of volunteers from the Bexar County Horticultural Advisory Committee, supplemented by monitors from the ET Program. Staff completed preliminary reports for meetings on August 31, November 2 and January 12. The data and tentative conclusions were discussed and revised through the discussions.

The 1999 ET Study began on June 21 and continued through November 1, 1999. Lawn ratings in the 1999 Study were consistent with ratings of 1997 and 1998. Turfgrass located in shade was compared in the Study. Turfgrass in the shade was irrigated at 0.75 of recommended ET and results were positive; the turf did not suffer and remained strong, holding acceptable green color throughout the Study period.

Media support to initiate the city-wide volunteer ET Program also began in June. The ET Promotion Team, consisting of Calvin Finch, Rene Mosqueda, Joe Taylor, Chris Brown, Humberto Ramos and Don McCauley, met with five local television stations and the *San Antonio Express-News*. The newspaper agreed to print ET information daily and continue to print daily information through 2000. Channel 29 TV Meteorologist Alex Garcia included ET Water Rates for St. Augustine, Bermuda and Buffalo from June through October on a daily basis. Channel 5 TV Meteorologist Albert Flores included ET Water Recommendations on weekends from June through October in 1999.

It is proposed to initiate this program in the summer of 2000, beginning in May and continuing through October, for television stations and continue daily information through the *San Antonio Express-News* newspaper.

ET PROJECT ADVISORY COMMITTEE

Brown, Chris	San Antonio Water Systems
Dennison, Russell	ET Monitor
Emory, Dee	Bexar County Master Gardener
Fipps, Guy	Associate Professor and Extension Agricultural Engineer
Hammer, Carrie	ET Monitor
Kissinger-Ayala, Kim	ET Monitor
Mote, Al	ET Monitor
Mullens, Vernon	Bexar County Master Gardener
Nichols, Dana Bohne	San Antonio Water System
Perkins, Loris	ET Project Monitor
Ramos, Humberto	San Antonio Water System
Suarez, Frank	Landscape Contractor
Taylor, Joe	ET Project Team
Taylor, Dr. Gene	Assistant Professor and Extension Turfgrass Specialist
Troy, John	Landscape Architect
Warren, Cleon	ET Monitor
Watjie, Wilbur	ET Project Team
Zavala, Leticia	Landscape Contractor

Potential ET & Weather Summary

San Antonio

June 1999

Date	*PET* (inches/day)	*Temp* (deg_F) Max	Min	*Min_RH* (%)	*Solar Radiation* (MJ/m^2)	*Rain* (inches)	*Avg Wind* (mph) 4 a.m.	4 p.m.
6/20	0.04	77	72	94	3.8	1.3	2.0	2.3
6/21	0.06	76	71	86	6.3	1.0	2.0	5.0
6/22	0.13	87	74	58	16.9	0.1	1.4	5.5
6/23	0.19	90	76	49	22.0	0.0	4.6	4.6
6/24	0.18	90	77	55	21.2	0.0	2.9	5.2
6/25	0.17	89	76	60	20.2	0.1	0.9	2.8
6/26	0.17	90	75	58	19.3	0.0	2.2	5.2
6/27	0.15	91	78	57	15.6	0.0	4.7	5.5
6/28	0.22	92	78	54	25.1	0.0	4.8	5.7
6/29	0.17	89	78	58	17.7	0.0	5.1	4.5
6/30	0.23	92	77	45	25.4	0.0	6.3	7.3
7/1	0.22	92	76	49	24.1	0.0	5.4	8.2

Potential ET & Weather Summary

San Antonio

July 1999

Date	*PET* (inches/day)	*Temp* (deg_F) Max	Min	*Min_RH* (%)	*Solar Radiation* (MJ/m^2)	*Rain* (inches)	*Avg Wind* (mph) 4 a.m.	4 p.m.
7/1	0.22	92	76	49	24.1	0.0	5.4	8.2
7/2	0.22	92	77	49	23.7	0.0	5.3	7.7
7/3	0.17	89	77	57	18.6	0.2	3.9	5.5
7/4	0.14	84	74	65	15.5	0.1	1.0	3.2
7/5	0.18	90	72	45	22.7	0.0	0.4	4.5
7/6	0.19	91	74	42	23.3	0.0	0.7	2.5
7/7	0.19	92	74	47	22.3	0.0	0.5	3.9
7/8	0.21	93	75	44	24.0	0.0	0.4	4.3
7/9	0.23	92	75	43	26.4	0.0	1.6	5.3
7/10	0.19	90	76	49	22.0	0.2	1.9	4.9
7/11	0.12	89	71	53	13.9	0.3	0.4	2.0
7/12	0.19	90	68	45	24.2	0.0	0.4	2.8
7/13	0.17	91	73	43	20.0	0.0	0.4	3.4
7/14	0.23	92	76	37	25.9	0.0	3.0	6.6
7/15	0.24	93	74	34	27.1	0.0	4.5	7.0
7/16	0.21	92	75	44	23.9	0.0	2.1	5.1
7/17	0.15	85	75	59	16.2	0.0	1.2	5.6
7/18	0.16	89	73	51	19.4	0.1	0.4	4.2
7/19	0.19	90	74	49	23.4	0.0	0.4	4.2
7/20	0.15	87	74	57	16.4	0.0	0.6	6.8
7/21	0.12	88	74	53	13.6	0.0	2.0	7.8
7/22	0.20	92	75	40	24.3	0.0	1.9	5.6
7/23	0.23	94	76	31	26.8	0.0	2.4	3.5
7/24	0.22	95	73	28	25.5	0.0	0.7	3.7
7/25	0.23	92	74	40	26.8	0.0	0.6	4.9
7/26	0.22	93	75	39	24.3	0.0	1.8	5.3
7/27	0.21	93	77	44	22.3	0.0	1.8	5.9
7/28	0.23	94	76	36	25.6	0.0	2.6	4.2
7/29	0.24	97	75	30	26.7	0.0	1.5	5.6
7/30	0.24	98	75	29	25.9	0.0	3.0	5.4
7/31	0.24	97	77	33	25.8	0.0	4.2	5.8

Potential ET & Weather Summary

San Antonio

August 1999

Date	*PET* (inches/day)	*Temp* (deg_F) Max	Min	*Min_RH* (%)	*Solar Radiation* (MJ/m^2)	*Rain* (inches)	*Avg Wind* (mph) 4 a.m.	4 p.m.
8/1	0.20	96	77	38	21.0	0.0	3.5	4.4
8/2	0.23	95	77	35	25.5	0.0	2.1	4.2
8/3	0.20	94	78	40	21.6	0.0	0.9	4.3
8/4	0.18	96	75	39	19.7	0.5	0.4	4.3
8/5	0.20	97	74	33	24.1	0.0	0.4	3.2
8/6	0.23	96	76	34	25.8	0.0	0.4	4.3
8/7	0.23	96	77	36	24.7	0.0	1.0	3.9
8/8	0.23	96	77	38	25.3	0.0	1.0	3.6
8/9	0.24	98	77	32	26.0	0.0	1.8	4.0
8/10	0.24	98	77	31	26.2	0.0	2.4	4.2
8/11	0.25	97	77	33	25.9	0.0	2.7	5.7
8/12	0.25	99	77	32	25.6	0.0	3.0	4.5
8/13	0.24	99	76	25	25.3	0.0	3.2	4.2
8/14	0.23	101	76	18	26.0	0.0	1.1	2.8
8/15	0.22	99	77	28	23.2	0.0	0.4	4.9
8/16	0.23	98	79	29	24.1	0.1	0.9	4.0
8/17	0.19	95	76	38	20.3	0.0	1.8	2.9
8/18	0.20	94	77	39	22.3	0.0	1.3	3.0
8/19	0.22	98	76	28	25.4	0.0	0.6	4.6
8/20	0.19	100	76	27	21.1	0.0	0.4	2.4
8/21	0.20	100	75	25	20.4	0.0	0.4	3.9
8/22	0.16	89	76	50	15.8	0.0	0.6	3.9
8/23	0.11	85	74	68	9.4	0.1	3.3	6.3
8/24	0.14	90	72	50	16.0	1.6	2.3	4.7
8/25	0.19	93	76	45	23.8	0.0	0.5	4.0
8/26	0.21	94	77	43	24.8	0.0	1.1	3.5
8/27	0.21	97	78	38	25.1	0.0	1.7	2.6
8/28	0.21	96	77	36	24.0	0.0	1.4	3.3
8/29	0.16	96	76	39	17.5	0.5	1.1	5.1
8/30	0.19	96	74	28	23.4	0.0	0.4	3.9
8/31	0.19	95	74	30	22.7	0.0	0.4	3.3

Potential ET & Weather Summary

San Antonio

October 1999

Date	*PET* (inches/day)	*Temp.* (deg_F) Max	Min	*Min_RH* (%)	*Solar Radiation* (MJ/m^2)	*Rain* (inches)	*Avg Wind* (mph) 4 a.m.	4 p.m.
10/1	0.14	84	58	27	19.5	0.0	0.4	4.2
10/2	0.13	89	62	39	18.5	0.0	0.6	3.3
10/3	0.13	91	74	45	17.8	0.0	2.8	4.0
10/4	0.14	86	70	43	16.5	0.0	0.5	5.6
10/5	0.15	88	65	36	18.5	0.0	2.0	3.5
10/6	0.14	87	65	31	18.5	0.0	0.4	3.5
10/7	0.15	87	59	25	19.7	0.0	0.4	4.2
10/8	0.12	88	67	36	16.0	0.0	1.3	2.2
10/9	0.16	86	68	31	19.0	0.0	3.0	3.2
10/10	0.14	88	66	32	16.7	0.0	1.1	3.2
10/11	0.13	87	69	34	16.0	0.0	0.6	3.9
10/12	0.12	87	67	34	15.3	0.0	0.5	2.6
10/13	0.12	88	65	33	17.0	0.0	0.4	3.3
10/14	0.12	87	67	42	13.5	0.0	0.4	3.2
10/15	0.12	87	72	45	13.6	0.0	2.3	4.9
10/16	0.11	87	72	47	11.9	0.0	3.2	3.9
10/17	0.08	73	51	75	4.2	0.4	0.7	6.4
10/18	0.05	53	48	70	2.7	0.2	5.2	1.6
10/19	0.07	65	46	41	12.5	0.0	3.4	4.7
10/20	0.09	73	46	25	19.5	0.0	0.4	2.3
10/21	0.09	76	46	24	18.9	0.0	0.4	2.0
10/22	0.09	86	49	18	18.7	0.0	0.4	1.8
10/23	0.13	80	61	19	18.8	0.0	2.1	4.2
10/24	0.12	77	53	19	18.7	0.0	0.9	2.3
10/25	0.10	79	50	27	17.2	0.0	0.4	2.8
10/26	0.10	79	53	31	17.7	0.0	0.4	3.0
10/27	0.10	79	54	39	15.3	0.0	0.4	5.2
10/28	0.09	81	63	45	12.5	0.0	0.5	6.0
10/29	0.10	83	66	51	12.0	0.0	1.1	6.3
10/30	0.09	69	54	47	8.7	0.4	5.0	5.7
10/31	0.09	71	49	39	14.8	0.0	0.6	4.2

Potential ET & Weather Summary

San Antonio

September 1999

Date	*PET* (inches/day)	*Temp* (deg_F) Max	Min	*Min_RH* (%)	*Solar Radiation* (MJ/m^2)	*Rain* (inches)	*Avg Wind* (mph) 4 a.m.	4 p.m.
9/1	0.18	93	76	38	20.7	0.0	1.2	2.8
9/2	0.20	94	76	38	22.9	0.0	2.0	3.4
9/3	0.20	94	76	39	22.2	0.0	2.3	4.2
9/4	0.18	93	78	44	18.1	0.0	2.8	5.1
9/5	0.18	93	77	43	21.2	0.0	2.6	4.0
9/6	0.16	92	73	46	20.1	0.0	0.5	6.2
9/7	0.16	90	72	48	19.8	0.0	0.4	4.3
9/8	0.18	93	75	46	22.3	0.0	1.1	3.5
9/9	0.18	95	74	37	22.1	0.0	0.4	4.3
9/10	0.19	92	74	39	21.5	0.0	0.4	4.8
9/11	0.20	92	74	39	21.4	0.0	2.4	5.1
9/12	0.19	92	76	37	21.5	0.0	3.6	4.4
9/13	0.15	89	73	40	15.1	0.0	0.4	5.3
9/14	0.16	89	71	40	19.0	0.0	2.2	3.0
9/15	0.15	90	72	31	18.6	0.0	0.4	2.9
9/16	0.18	90	69	20	23.2	0.0	0.5	3.6
9/17	0.18	90	65	27	22.6	0.0	0.4	3.9
9/18	0.17	90	69	36	22.2	0.0	0.4	2.8
9/19	0.17	93	69	25	22.5	0.0	0.4	2.7
9/20	0.17	97	70	25	22.0	0.0	0.4	2.7
9/21	0.22	85	70	35	20.8	0.0	5.7	5.7
9/22	0.19	84	65	11	23.3	0.0	3.1	2.5
9/23	0.16	86	55	15	23.4	0.0	0.4	2.6
9/24	0.15	88	62	30	19.9	0.0	0.4	4.3
9/25	0.12	86	71	52	11.7	0.0	3.0	5.0
9/26	0.15	91	73	41	17.9	0.0	2.5	5.9
9/27	0.17	91	74	37	18.8	0.0	3.5	5.8
9/28	0.15	92	74	40	18.6	0.0	2.3	2.2
9/29	0.19	78	62	26	14.0	0.0	8.2	5.7
9/30	0.14	81	58	23	20.0	0.0	1.4	2.8

Potential ET & Weather Summary

San Antonio

November 1999

Date	*PET* (inches/day)	*Temp* (deg_F) Max	Min	*Min_RH* (%)	*Solar Radiation* (MJ/m^2)	*Rain* (inches)	*Avg Wind* (mph) 4 a.m.	4 p.m.
11/1	0.10	80	53	37	17.0	0.0	0.7	4.4
11/2	0.15	65	48	18	17.3	0.0	6.8	6.7
11/3	0.10	68	40	19	17.2	0.0	1.0	3.8
11/4	0.08	79	48	35	16.5	0.0	0.4	4.9
11/5	0.09	81	60	41	15.0	0.0	1.0	5.1
11/6	0.09	78	61	42	13.7	0.0	0.4	4.1
11/7	0.10	78	59	27	16.9	0.0	1.4	2.6
11/8	0.09	76	51	27	14.8	0.0	0.4	3.6
11/9	0.08	78	53	39	14.6	0.0	0.4	4.4
11/10	0.07	77	58	44	12.1	0.0	0.4	2.1
11/11	0.08	81	63	41	13.6	0.0	0.8	2.3
11/12	0.08	79	59	41	10.3	0.0	0.4	2.3
11/13	0.08	81	54	29	15.2	0.0	0.4	2.1
11/14	0.08	80	51	27	14.2	0.0	0.4	2.8
11/15	0.08	82	54	26	15.0	0.0	0.4	2.4
11/16	0.08	81	54	27	14.2	0.0	0.4	1.8
11/17	0.07	76	53	51	9.3	0.1	0.4	3.6
11/18	0.07	81	59	46	10.1	0.0	0.4	5.3
11/19	0.06	78	66	38	6.4	0.0	4.0	1.2
11/20	0.10	75	56	29	13.9	0.0	1.7	2.4
11/21	0.06	78	63	56	7.9	0.0	2.2	5.3
11/22	0.08	81	66	50	9.2	0.0	3.9	6.8
11/23	0.12	75	56	20	14.5	0.0	0.4	5.3
11/24	0.09	56	46	44	2.8	0.0	5.3	4.3
11/25	0.07	61	39	30	14.5	0.0	4.0	2.5
11/26	0.06	68	37	26	14.6	0.0	0.4	3.7
11/27	0.06	76	42	30	14.4	0.0	0.4	4.4
11/28	0.06	77	50	43	13.5	0.0	0.5	2.1
11/29	0.08	74	53	36	13.2	0.0	0.6	4.0
11/30	0.07	67	54	43	9.3	0.0	2.2	3.2

DISCUSSION AND RESULTS OF 1999 WATER STUDY

1. Water use at 100% ET used in this experiment was 11.5 inches which would represent a 9.5 inch savings to the recommended 1 inch per week rate. If systems were automated to shut off during rain events, that savings would have been 4.0 inches during the 20-week study. Bermudagrass and St. Augustine in the shade at 75% ET had a usage of 7.0 inches of irrigation water recommended and Buffalo grass had only 4.0 inches of water recommended.

2. The hot summer of 1999 was stressful for turfgrass in full sun; however, St. Augustine watered at the 100% replacement rate faired extremely well. The average ratings of these lawns started at 3.8 of a possible 4 and only dropped to a 3.3 of a possible 4 rating during the week of July 19-26. Ratings rebounded and maintained a 3.5 average rating through September and, at the beginning of October, returned to a 3.8 rating. This turf, we feel, could be stressed even more, and we recommend lowering the replacement rate from 100% ET to 90% ET for St. Augustine in full sun.

3. We recommend to treat Zoysiagrass in full sun the same as St. Augustine in full sun.

4. St. Augustine turf in the shade, watered at the 100% replacement rate, did suffer from yellowing color. Turfgrass quality varied from 2.8 in June to a low of 2.2 in August and then rebounded to 3.0 in October. St. Augustine in the shade at the 75% replacement rate varied from a 4.0 rating in June to a low of 2.45 in August and September and rebounded to a 3.0 rating in October. The 75% replacement rate for St. Augustine in shade conditions looks to be right on target.

5. Zoysiagrass in the shade at 75% ET was not a good test; there was only one turfgrass site in this segment. The turf started at a 3 rating, fell to a 2 rating and then held the 2 rating for the duration of the study. More zoysiagrass at the 75% replacement rate would help to validate this study.

6. St. Augustine in shade at the 50% replacement had the largest number of participants. The average rating at the start of the study was 3.1 in June. The rating slowly declined to 2.4 in August and then began to improve in September to 2.6 and to 2.7 by October. These lawns did recover completely by spring. In situations where there is a well-established turf and dense shade, the 50% replacement rate may be enough additional irrigation. We have testimonials of clients who watered in these conditions only one time last summer.

7. St. Augustine in full sun at the 50% replacement rate did show the largest variation of all the turf sites. The average rating in June started at 4.0 and then began to decline to a 3.0 in late July and 2.7 in September. By October, the turf had rebounded to an average quality of 3.3 rating which suggests that at the 50% replacement rate, this grass will definitely decline in quality yet will rebound as conditions improve. In severe drought, the 50% replacement rate may be considered to keep St. Augustine turf alive but at a lower quality rating.

Water Use for 1999 ET Participants					
Week	**Date**	**Rain**	**St. Augustine (Full Sun)**	**Bermuda (Full Sun) or St. Augustine (Shade)**	**Buffalo**
1	6/21	2.3"	Wait	Wait	Wait
2	6/28	0.2"	Wait	Wait	Wait
3	7/5	0.4"	1.0"	0.75"	0.50"
4	7/12	0.5"	Wait	Wait	Wait
5	7/19	0.1"	0.50"	0.50"	Wait
6	7/28	None	0.50"	Wait	0.50"
7	8/2	0.5"	1.0"	0.75"	0.50"
8	8/9	0.5"	0.5"	Wait	Wait
9	8/16	None	1.0"	0.75"	0.50"
10	8/23	None	0.75"	0.50"	Wait
11	8/30	2.1"	Wait	Wait	Wait
12	9/6	None	0.0"	0.75"	0.50"
13	9/13	None	0.75"	0.50"	Wait
14	9/20	None	0.75"	0.50"	0.50"
15	9/27	None	0.75"	0.50"	Wait
16	10/4	None	0.75"	0.50"	0.50"
17	10/11	None	0.75"	0.50"	Wait
18	10/18	0.6"	0.50"	Wait	Wait
19	10/25	None	0.50"	0.50"	0.50"
20	11/1	0.4"	0.50"	Wait	Wait
TOTAL			**11.5"**	**7.0"**	**4.0"**

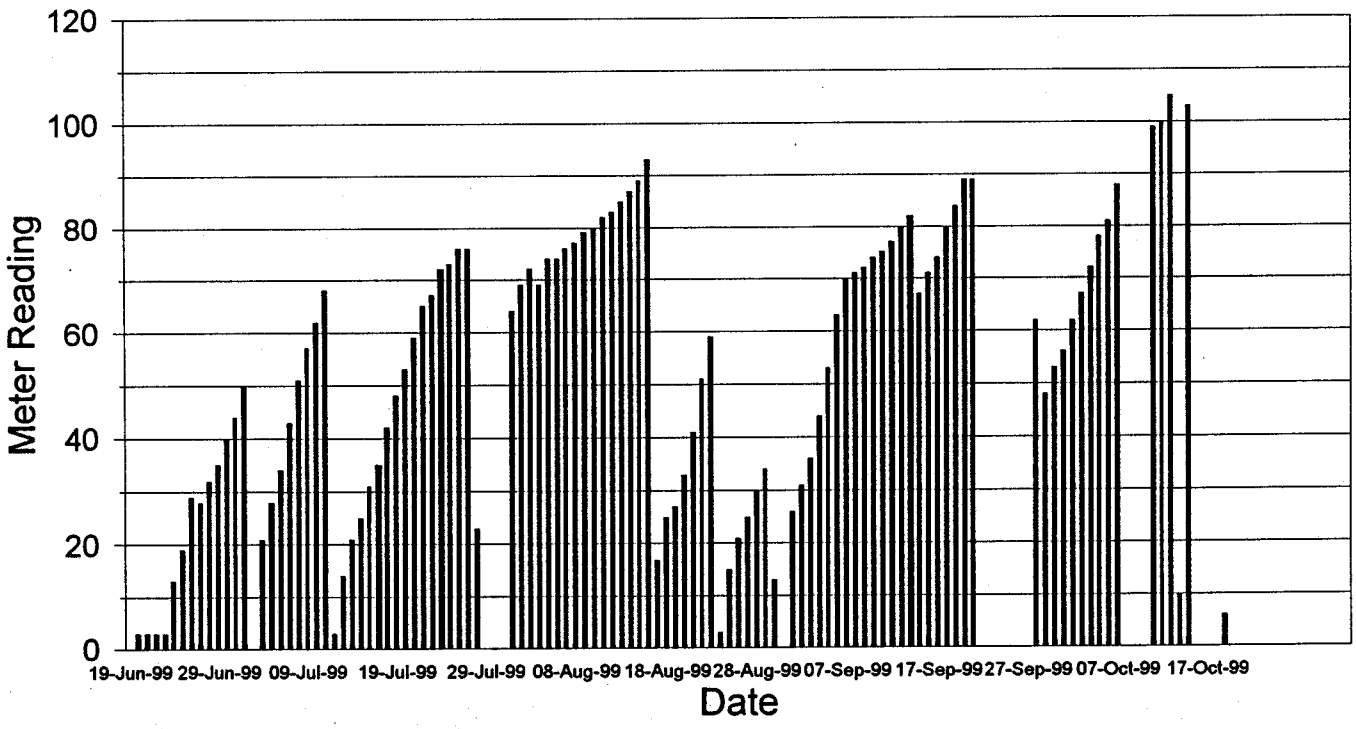
Rule of thumb for St. Augustine: Apply 1" water/week (20" total or 15.5" if they did not water during rain events of 0.50" or more)

1999 ET Lawn Ratings

Name	Turf	Sun/ Shade	% Replacement	JUNE			JULY				AUGUST					SEPTEMBER				OCTOBER		
				14	21	28	5	12	19	26	2	9	16	23	30	5	13	20	27	4	11	18
Becky Smith	St Augustine	shade	50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Maria Pope	St Augustine	shade	50	3	3	3	4	4	4	3	3	3	2	2	3	2	3	3	2.5	3	4	4
Darrell Bach	St Augustine	shade	50	4	4	2	2	2	2	2	1	1	1	1	1	2	2	2	2	3	3	3
Al Mote	St Augustine	shade	50	3	3	3	3	3	3	3	3	2	3	3	3	2	2	2	2	2	1	2
Al Mote	St Augustine	shade	50	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	2
Sandra Prescher	St Augustine	shade	50	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Robert Sandefer	St Augustine	shade	50	3	3	3	2	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2
Maria Garza	St Augustine	sun	50	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	4	4	4
Russell Denison	St Augustine	sun	50	4	4	4	4	4	3	2	3	3	3	3	3	2	2	2	2	2	2	2
Debbie McCleary	St Augustine	sun	50	4	4	4	3	3	3	3	2	2	2	2	2	3	3	3	3	4	4	4
Roxanne McDaniel	Zoysia	shade	50	4	4	4	4	4	4	4	2	2	2	2	2	2	2	2	2	2	2	3
Lorriane Beere	Zoysia	shade	50	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3	3	3	3	3
Sharon Swain	Zoysia	shade	50	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Paul Ziaza	Zoysia	shade	50	4	4	4	3	3	3	3	2.5	2.5	3	3	2.5	2.5	2	1.5	1.5	1.5	2	2
Robert Artle	Zoysia	shade	50	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Sharon Swain	Zoysia	sun	50	4	4	4	3	3	3	3	2.5	2.5	3	3	3	3	3	2	2	3	3	4
Lorriane Beere	Zoysia	sun	50	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Robert Artle	Zoysia	sun	50	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Loris Perkins	St Augustine	shade	75	4	4	4	4	4	4	4	4	2.5	3	4	4	4	3.5	3	3	3	3.5	4
Wade Oldham	St Augustine	shade	75	4	4	4	3	3	3	3	3	3	2	3	3	2	2.5	2.5	2	2	2	2
Harold Williams	St Augustine	sun	75	4	4	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2
Mike Brosan	St Augustine	sun	75	3	3	3	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4
Gary Simmons	St Augustine	sun	75	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Wilbur Watje	St Augustine	sun	75	4	4	4	4	4	3.5	3.5	3.5	3.5	3.5	4	3.5	3.5	3.5	4	4	4	4	4
Mary Jo Nelson	Zoysia	shade	75	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Paul Ziaza	Zoysia	sun	75	4	4	4	3	3	3	3	2.5	2	2.5	2.5	2.5	2.5	2.5	2	1.5	1.5	2	2
Joe Taylor	Zoysia	sun	75	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Mary Jo Nelson	Zoysia	sun	75	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	3	3	3
Karen Guz	Zoysia	sun	75	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	2	2
Barry Spiegel	St Augustine	shade	100	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3
Weldon Land	St Augustine	shade	100	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.5	2.5	3
Donna Francis	St Augustine	shade	100	3	3	3	3	3	3	3	2.5	3	3	3	3	2	2	2	2	3	3	3
Arlene Yender	St Augustine	sun	100	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3.5	3.5
Donna Francis	St Augustine	sun	100	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	3	3	3
Earl Putnam	St Augustine	sun	100	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Cleon Warren	St Augustine	sun	100	4	4	4	4	4	3	2	4	4	4	4	4	4	4	4	4	4	4	4
Wilbur Watje	St Augustine	sun	100	4	4	4	4	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4	4
Jo Long	Zoysia	shade	100	3	4	4	3	3	2	2	3	3	4	4	4	4	4	4	4	4	4	4
Carrie Hammer	St Augustine	shade	0	4	4	4	4	4	4	4	3	3	3	3	3	2	2	2	2	3	3	3
Carrie Hammer	St Augustine	sun	0	3	3	3	3	3	3	3	2	2	2	2	2	2	1	1	1	1	1	1

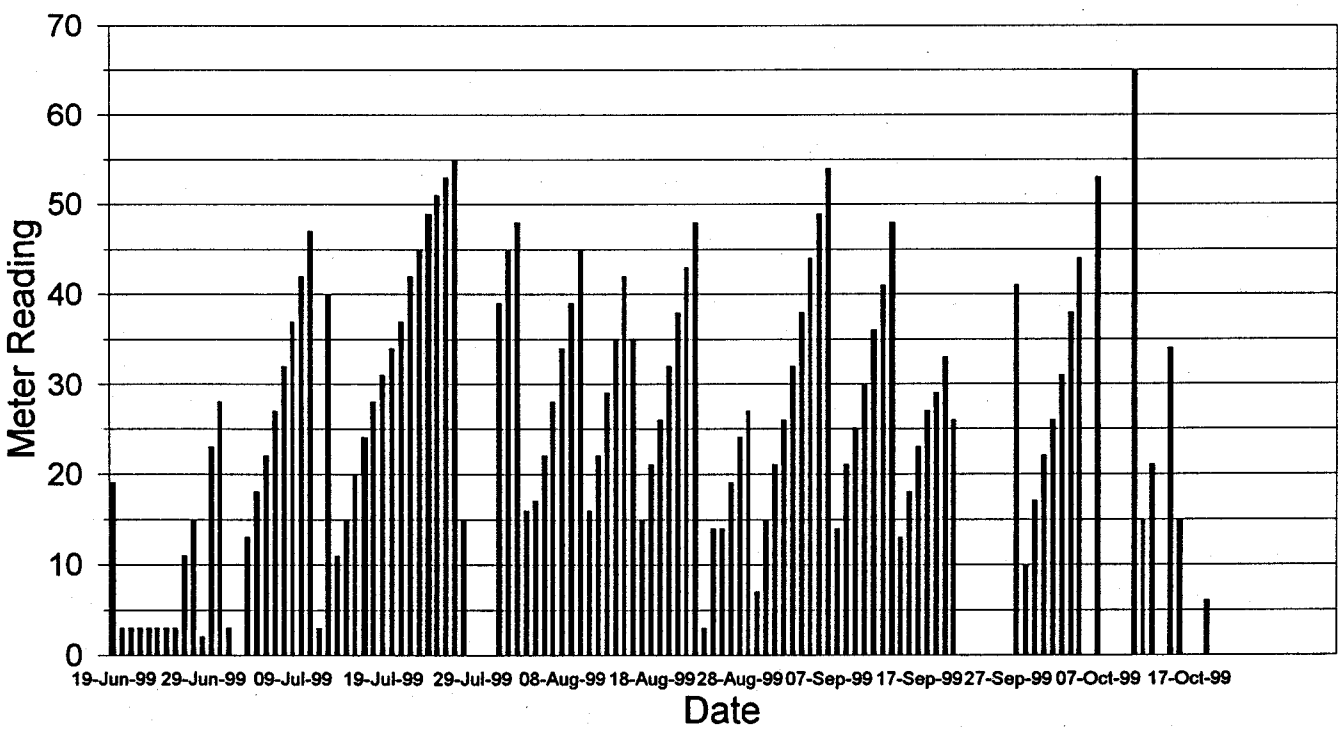
SOIL MOISTURE

Al Mote (Front Yard)



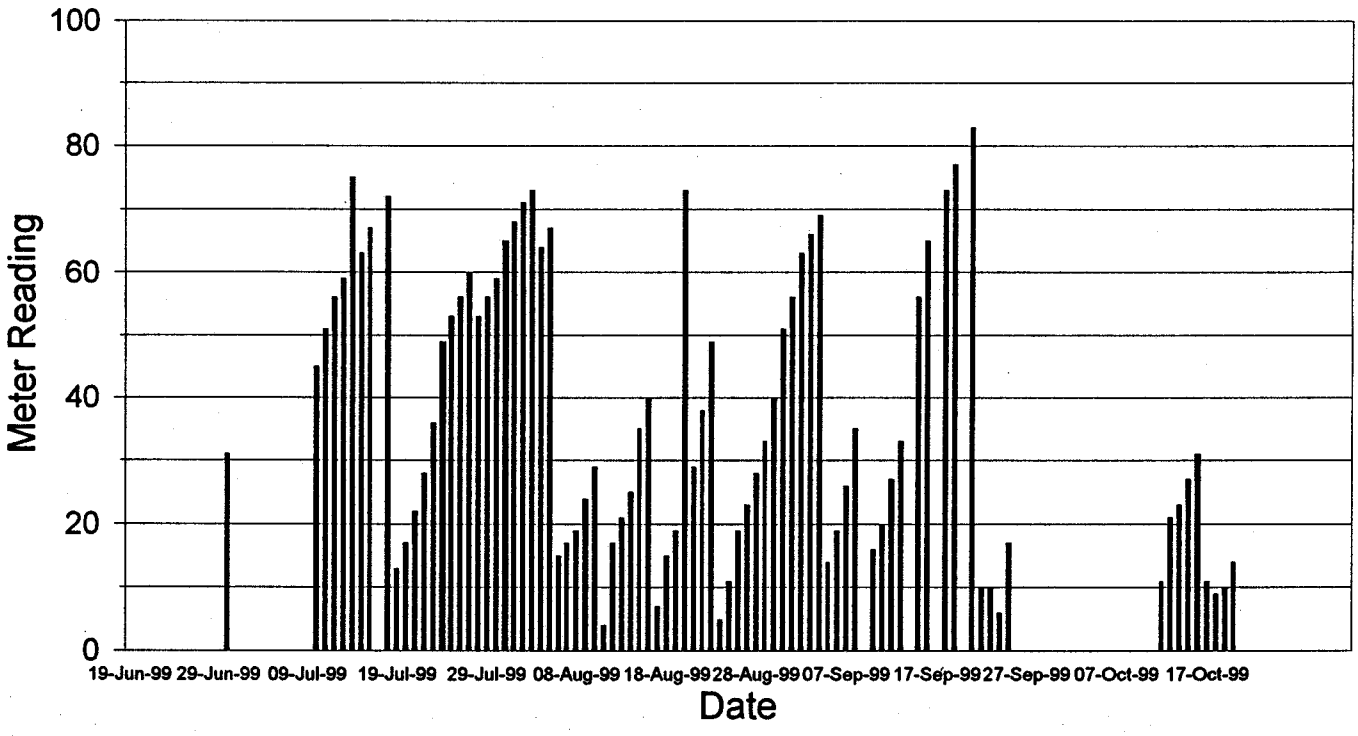
SOIL MOISTURE

Al Mote (Back Yard)



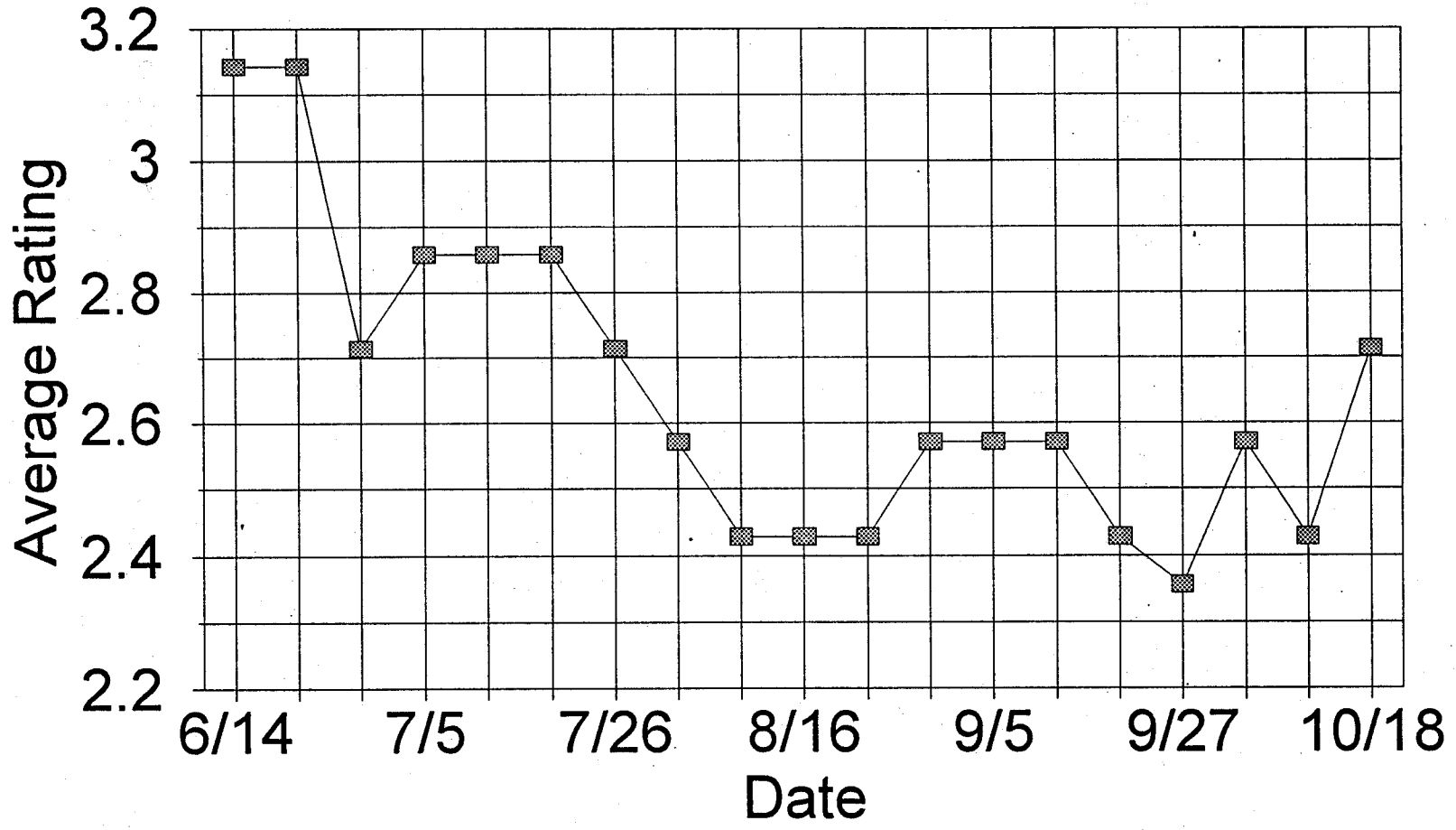
SOIL MOISTURE

Russell Denison



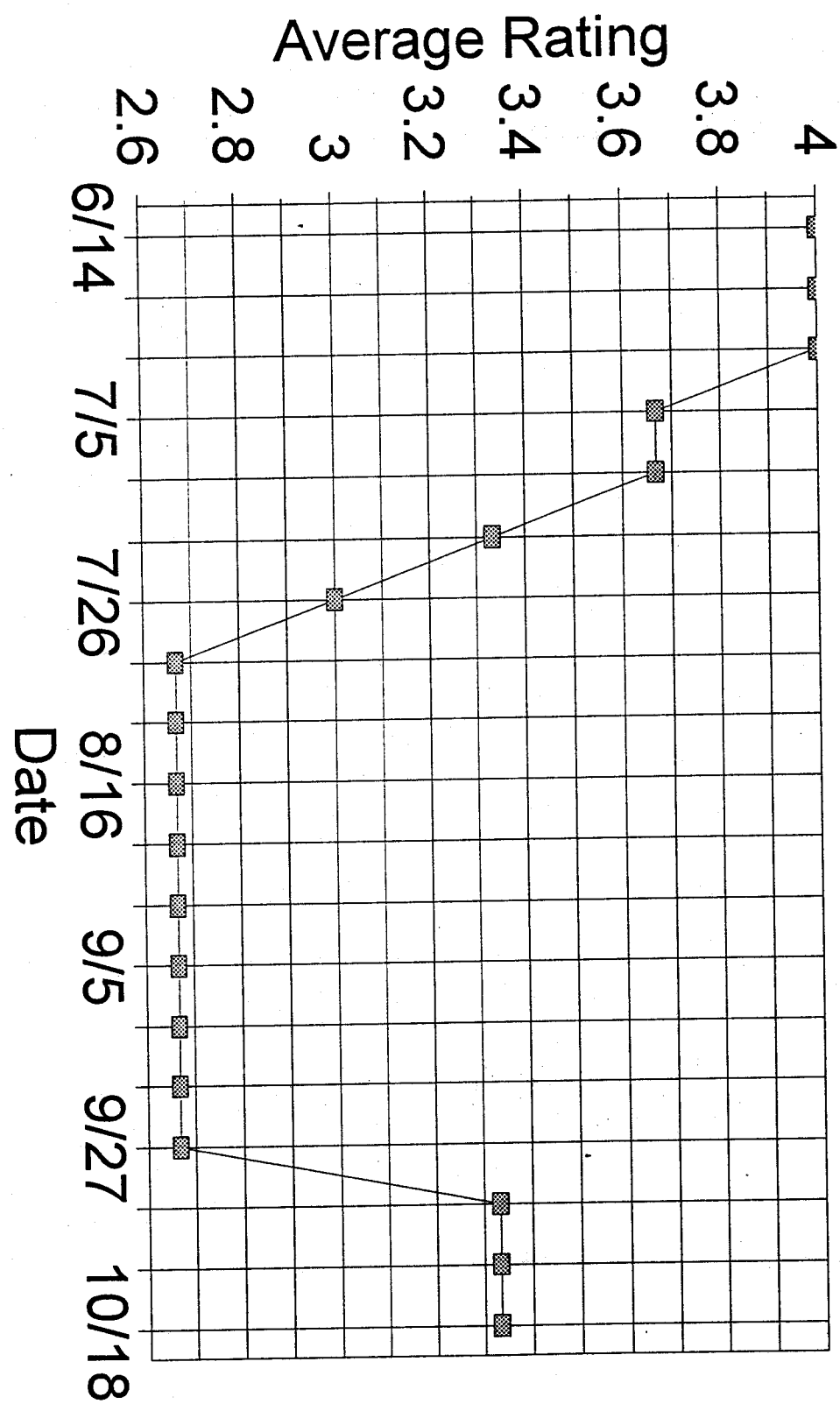
St. Augustine (Shade)

50% Replacement



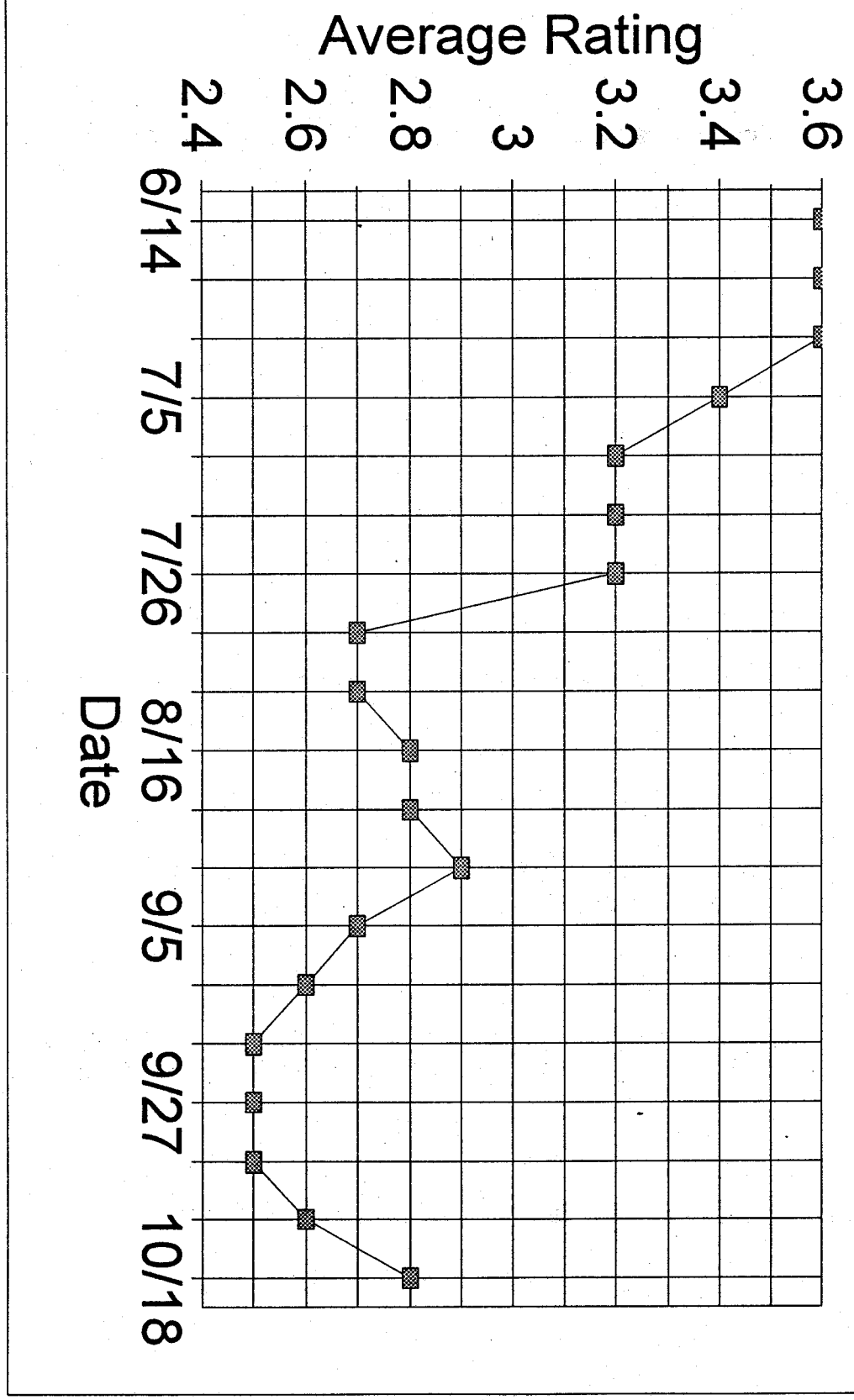
St. Augustine (Sun)

50% Replacement



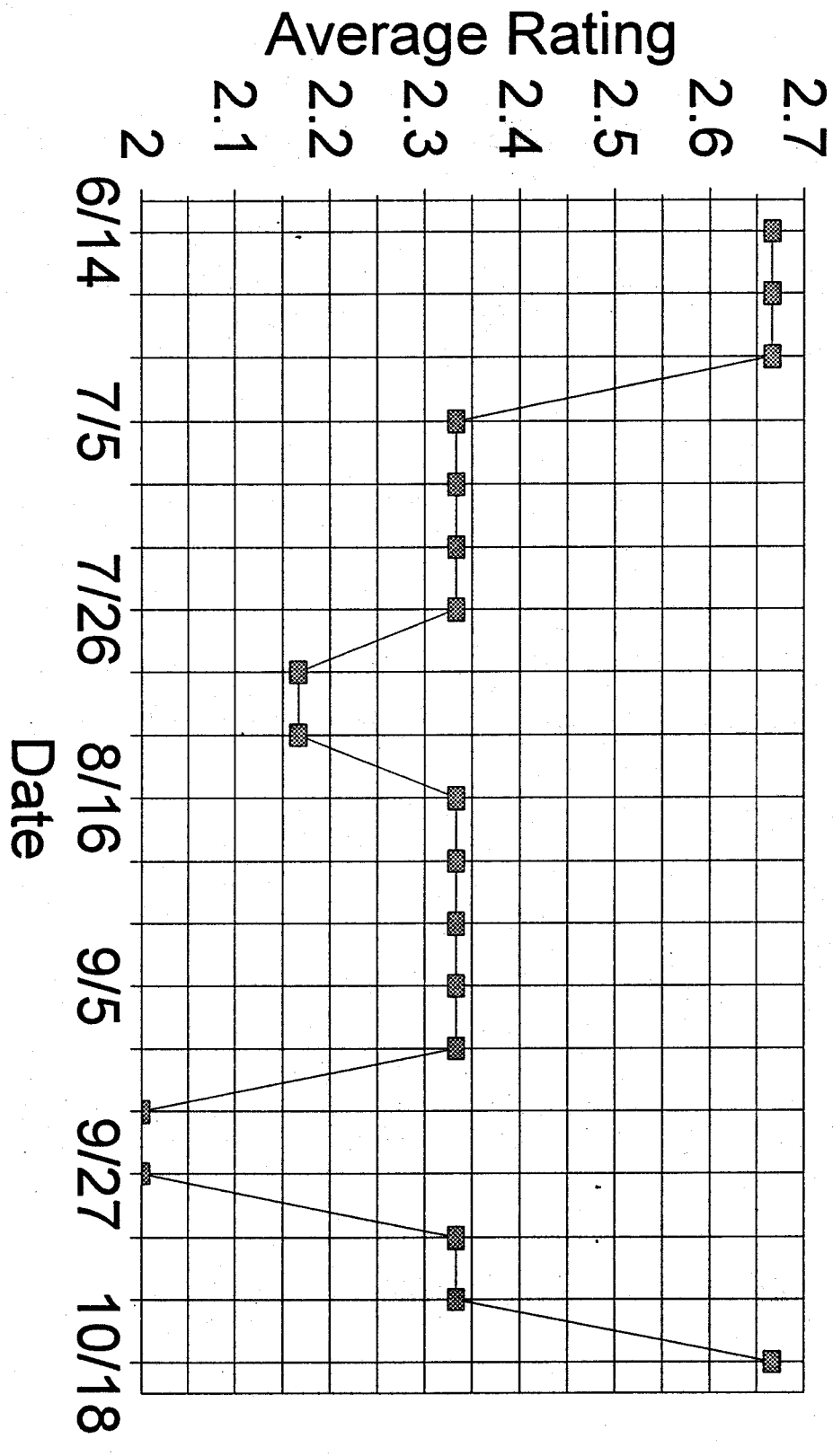
Zoysia (Shade)

50% Replacement



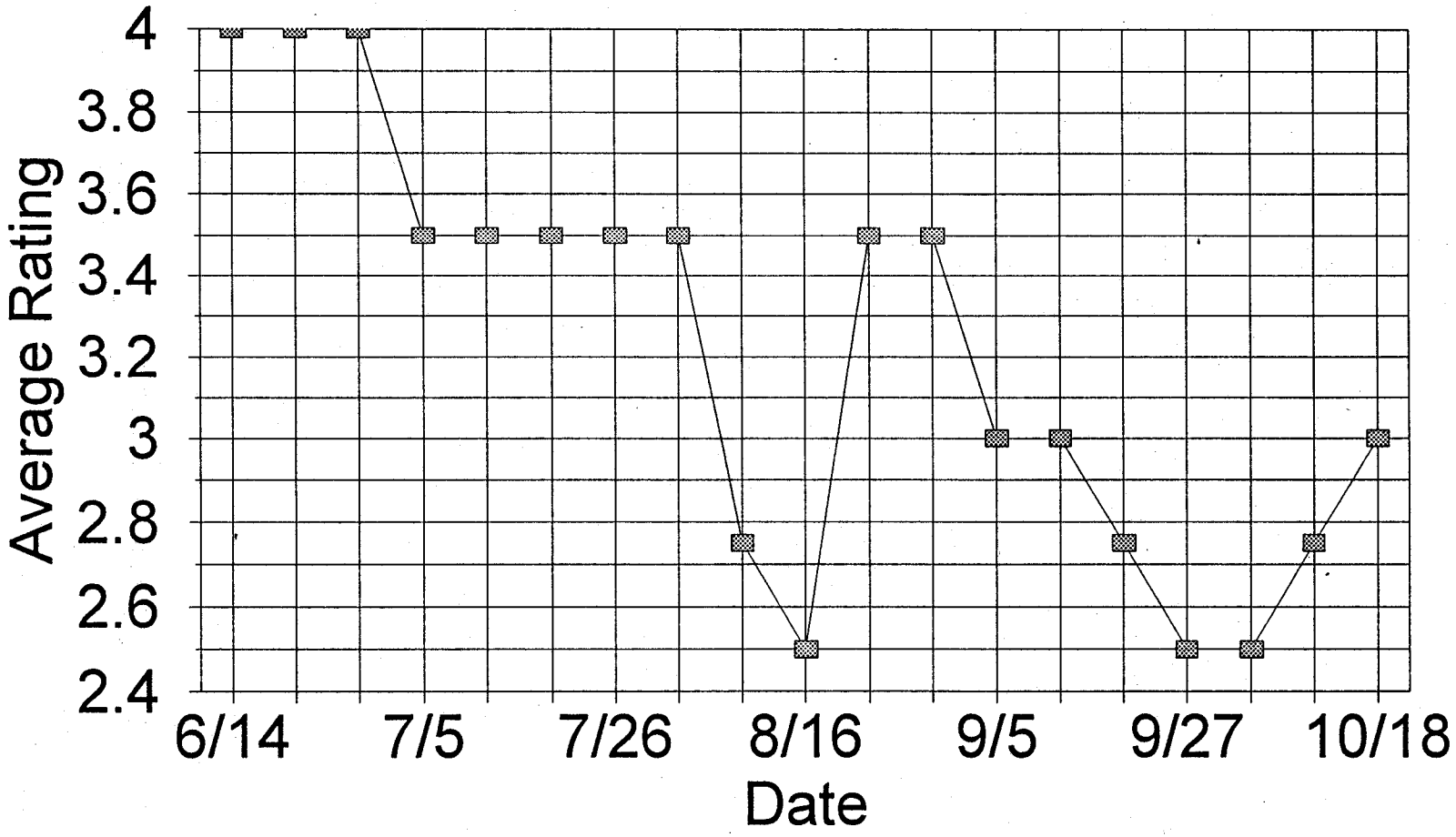
Zoysia (Sun)

50% Replacement



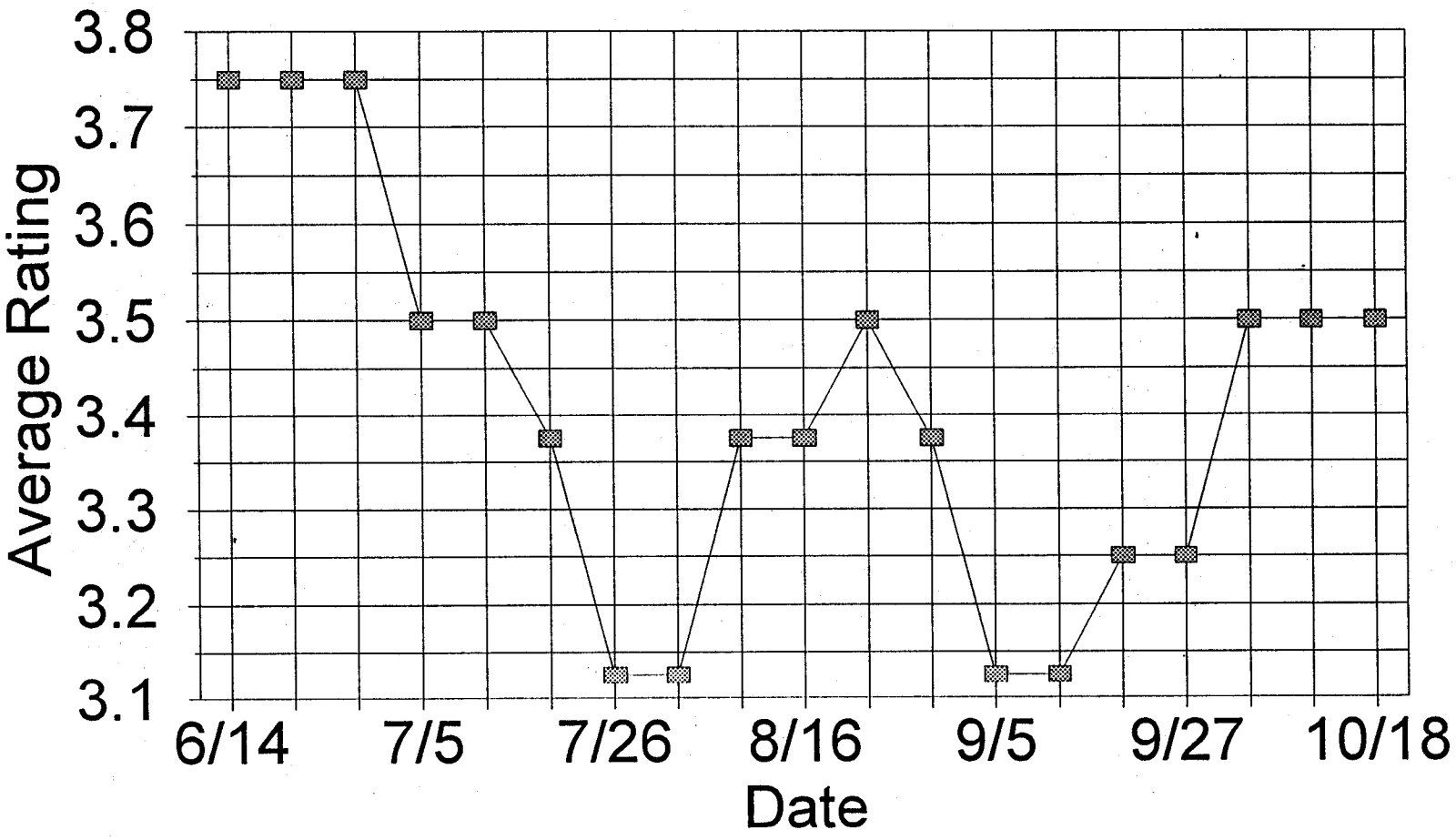
St. Augustine (Shade)

75% Replacement



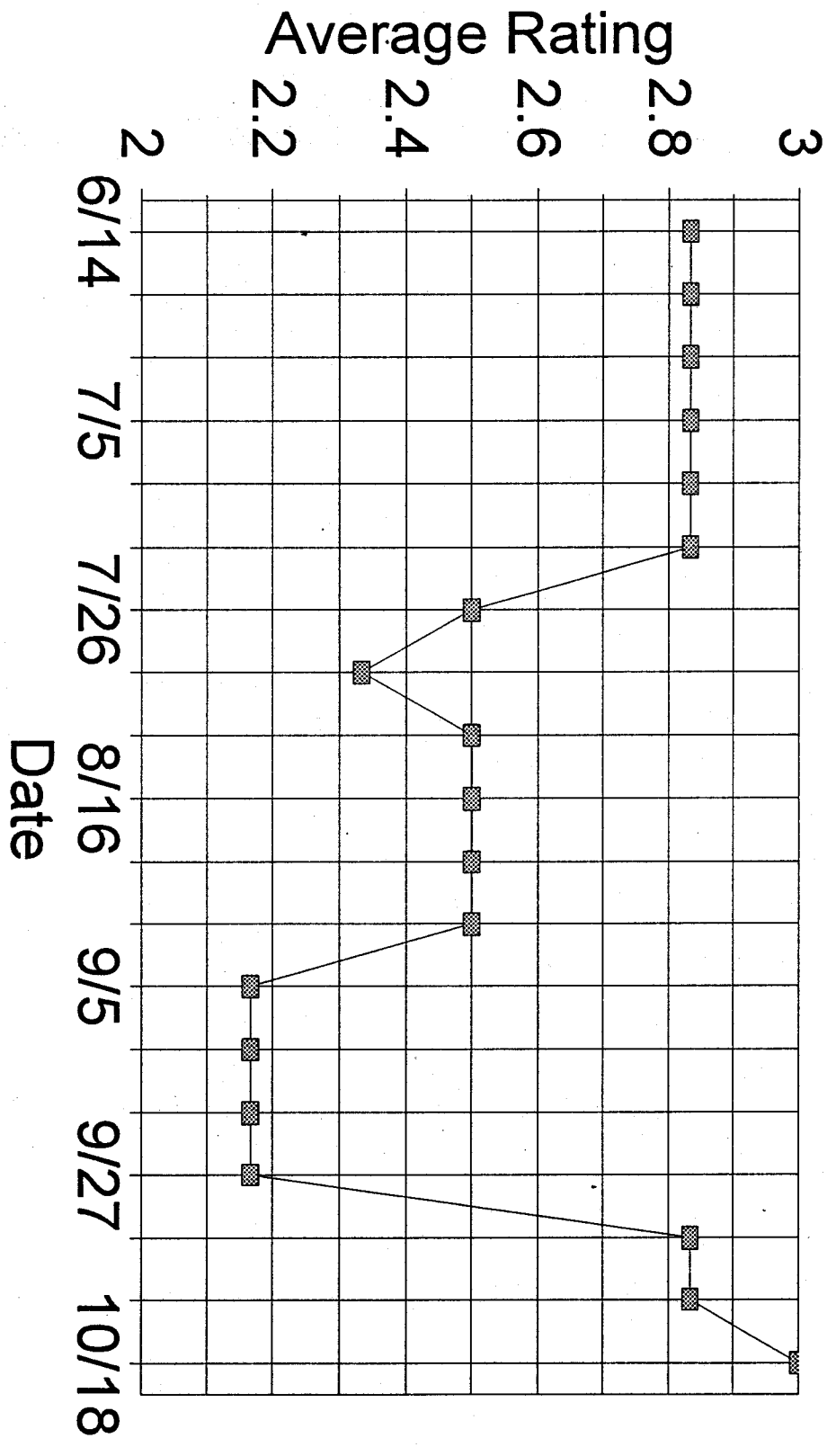
St. Augustine (Sun)

75% Replacement



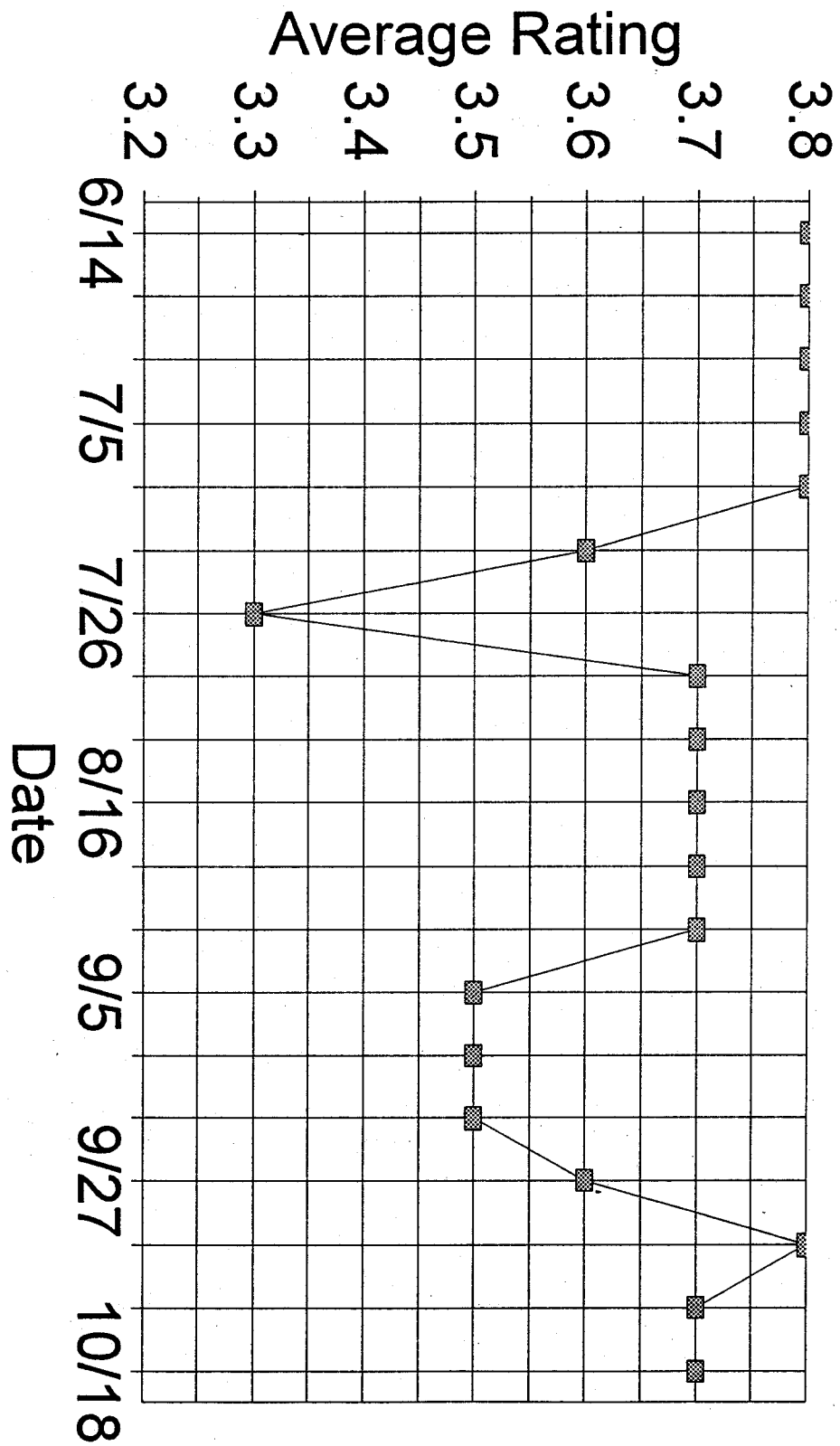
St. Augustine (Shade)

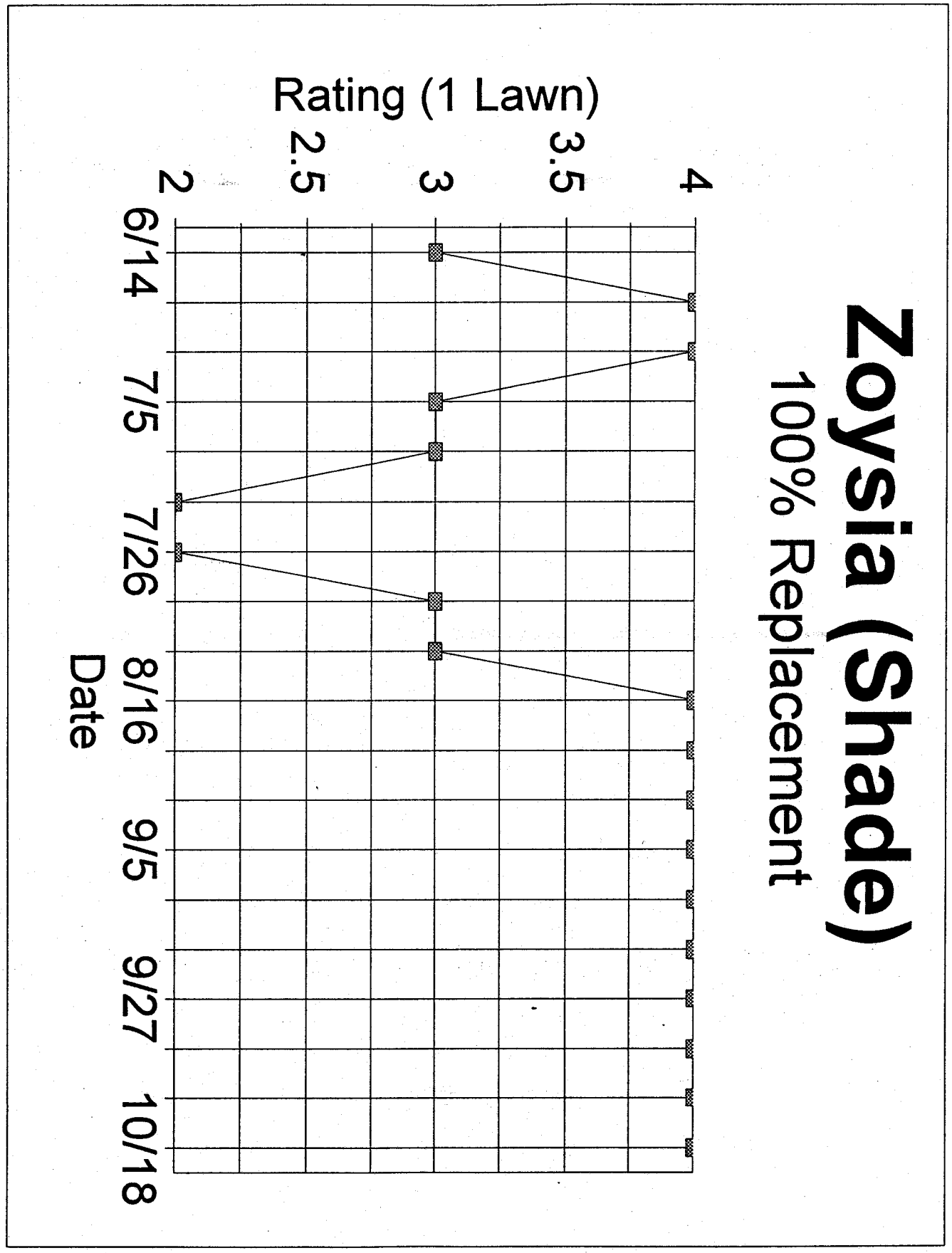
100% Replacement



St. Augustine (Sun)

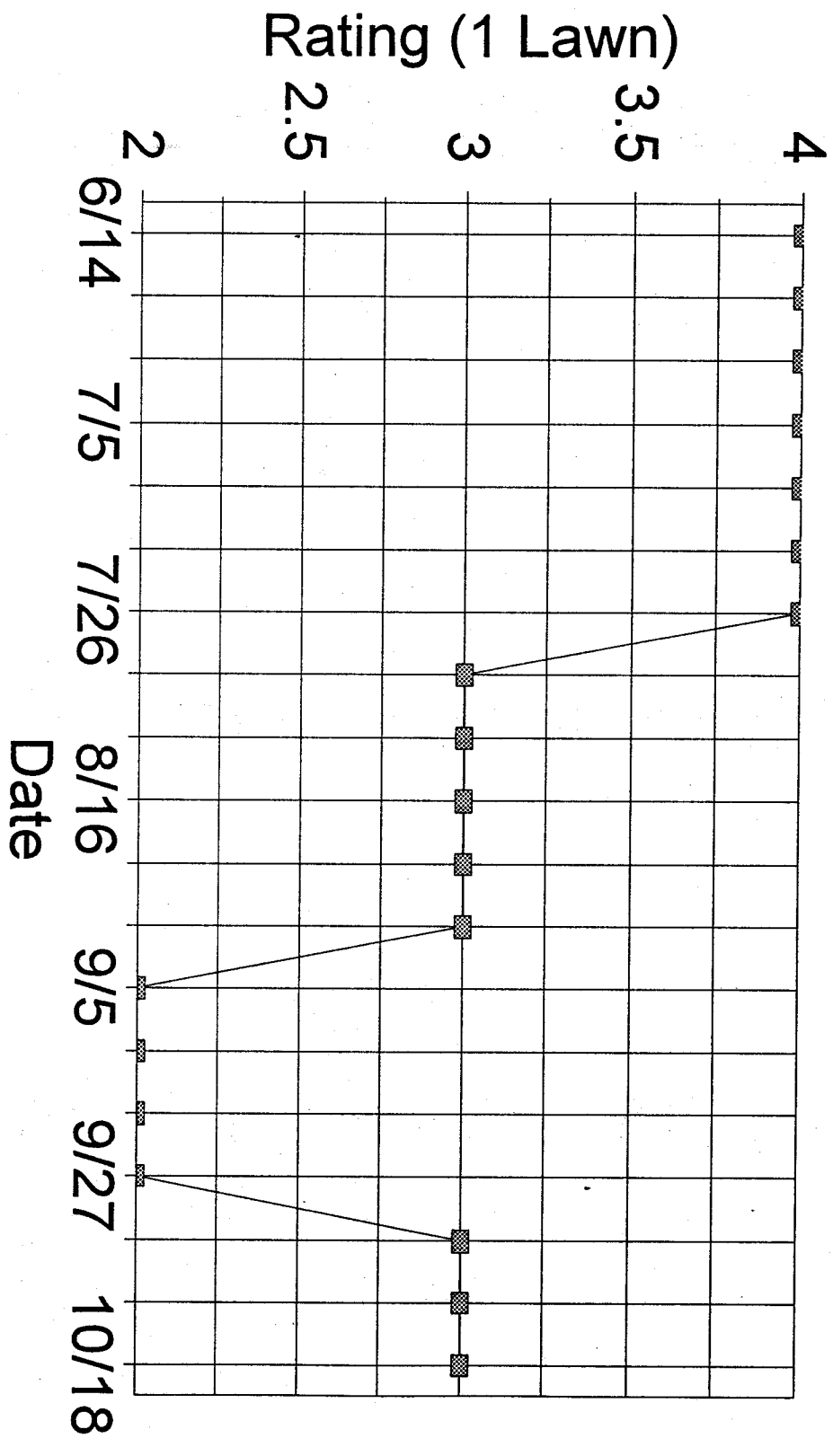
100% Replacement




Zoysia (Shade)
100% Replacement
Rating (1 Lawn)
2
2.5
3
3.5
4
6/14
7/5
7/26
8/16
9/5
9/27
10/18
Date

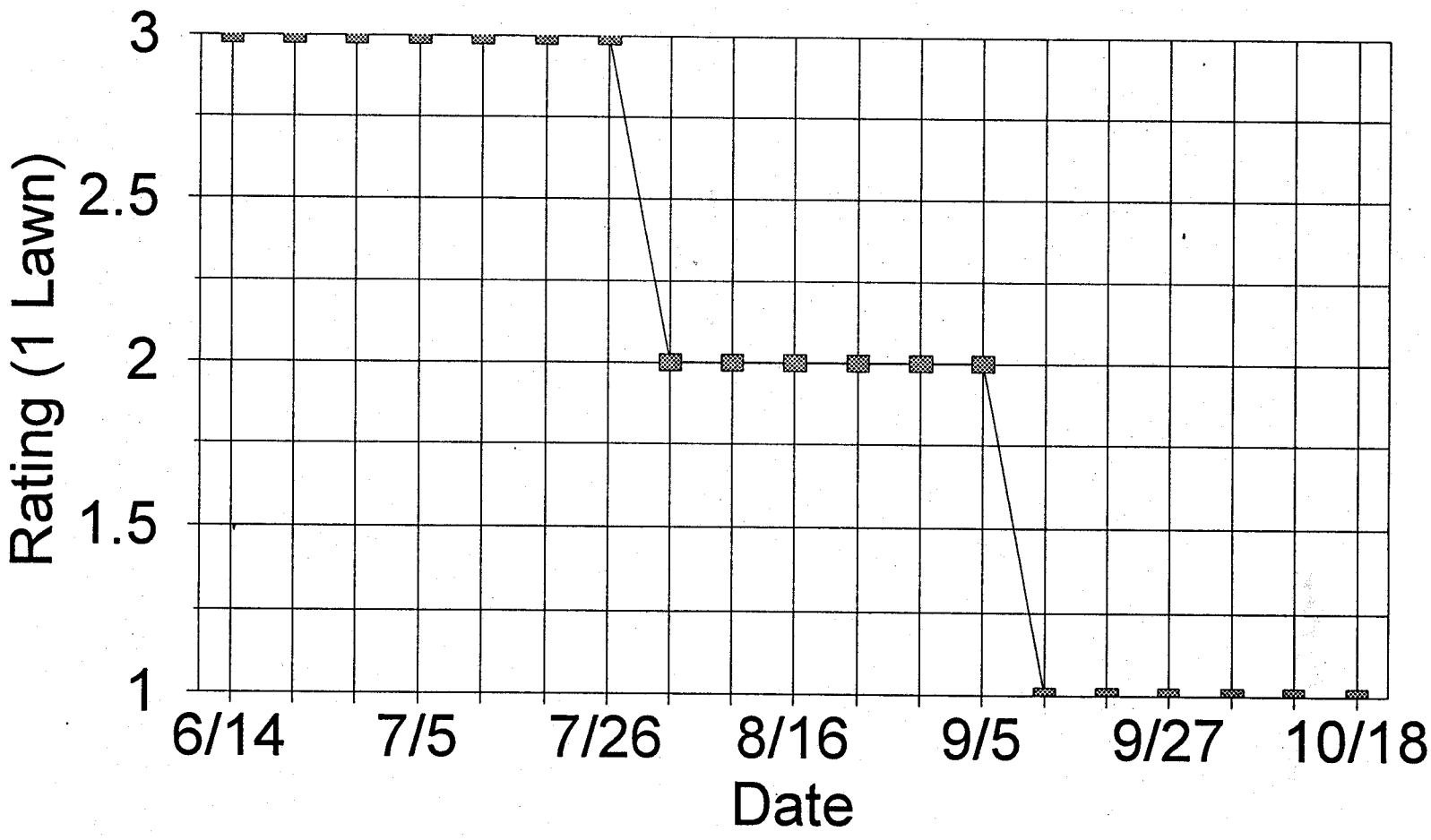
St. Augustine (Shade)

0% Replacement



St. Augustine (Sun)

0% Replacement



ET

PROCEDURE HANDBOOK

1999

EVAPO-TRANSPIRATION PROJECT
Summer 1999

Project Goals:

1. To conserve water by irrigating on the basis of evapo-transpiration data.

2. To determine the best ET based watering practices for San Antonio.

3. To utilize the results of the second years project to develop a broad ET Based Lawn Watering Program.

Project Partners:
Texas Agricultural Extension Service
Bexar County Master Gardeners
Texas A&M University
San Antonio Water System

How the Project Will Work: Our weather station located at the Jones-Maltsberger demonstration site collects data necessary to calculate evapo-transpiration rates. We will determine ET rates for each day and communicate them to you using our ET Phone Line. you will use the information on the ET Phone Line to follow the ET Study Protocol. The feedback you give us through your data sheets and comments will help us make any necessary adjustments in how we use the ET data.

Terms We Will Be Using:

Evapo-transpiration (ET) is water loss due to evaporation and transpiration.

Evaporation: This is the process which causes water out in the sun to disappear as water molecules change state from liquid to gas.

Transpiration: During transpiration water is taken up by plant roots, used in photosynthesis and released into the atmosphere.

Soil Water Reservoir: This refers to water stored in the soil under plants. The amount of water which can be held depends on the type of soil and the depth of soil. The amount that soil can hold is expressed in inches.

Water Application Rate: This refers to the amount of water that is applied to grass by a sprinkler system over a period of time. It is expressed in inches/hour. Your measure this by conducting a "catch-can" test while your sprinkler system is running.

Questions You May Have On The ET Program

Why is a Watering Program Needed? 25% of our potable water is used for landscape irrigation. During hot summer months, landscape irrigation may account for up to 60% of total water use. Because most people unknowingly over-water, this can be reduced through appropriate irrigation methods. Reducing our high water use will save money, assist in efforts to keep aquifer levels above drought levels and help assure that San Antonio will not be limited in growth capacity by water shortage.

How Does Watering Affect Grass Health? Appropriate water application is perhaps the most important factor contributing to turf quality. Watering too much and too often encourages shallow rooted grass which will not withstand the extreme heat of our summers. However, no irrigation results in brown and dormant grass that does not meet the quality preferences of most home owners.

Appropriate irrigation is thought to "drought train" grass by encouraging deep routs and lower water usage. Grass that is drought trained is thought to use less water, be more resistant to disease and to stay greener during the hottest parts of the summer.

How Do We Know How To Appropriately Water? Grass should be watered when the soil reservoir under grass is nearly depleted. When very little water is left in the soil, the grass will show signs of water stress. At this time, the reservoir shall be refilled. Waiting until the reservoir is nearly empty encourages grass roots to go deeper into the soil so that more of the soil reservoir is used.

What Are Signs of Water Stress? When grass is deprived of water in the soil, it becomes less firm and elastic. Grass that has enough water available will spring back after being stepped on. When a footprint is left in the grass, there is water stress. Other signs of stress include leaf blade curling, wilting and discolorations.

How Does ET Data Fit Into All of This? Evapo-transpiration data will give us an estimate of when the soil water reservoir is nearly depleted. We will refill the soil reservoir with only the needed amount of water. This should be healthy for the grass and should also conserve water.

Why is Your Participation In This Study Important? If our pilot program is successful, we will use information you provide to develop a city-wide ET based water conservation program. Your reactions to the pilot study will be critical in the design of any future program. No lawn care program works unless home owners find it simple to follow. The program must also result in grass the meets the aesthetic needs of home owners. Your attention to these issues will give us feedback we need to create a successful program for our city.

Please help us by staying in touch during the entire study period. We especially need your attention for the following areas:

- Fill in the data forms as completely as possible. We need to know about each of the topics listed on the bottom of the Calendar Data Sheet.
- Write extra information you think might be of interest.
- Call us with any questions. If something isn't clear, WE NEED TO KNOW!
- Tell us if your grass seems to be getting more water than it needs OR if you think it is looking too stressed to meet your aesthetic needs.

Why Isn't Everyone In the Study Doing the Same Thing? We will follow several different methods of applying ET data to a home lawn watering program.

The ET Project Team

The Evapo-transpiration Study is a joint project being conducted by the Texas Agricultural Extension Service, the Bexar County Master Gardeners and Texas A&M University. Funding to complete the study was provided by San Antonio Water System.

Texas Agricultural Extension Service: The ET Study is being directed by Bexar County Office of the Texas Agricultural Extension Service. Joe Taylor (County Extension Agent-Agriculture) and Edna Ortiz (County Extension Agent-Horticulture) will conduct all training. They will be actively involved in the ET implementation and will be pleased to address questions or concerns you may have.

Bexar County Master Gardeners: The Bexar County Master Gardeners have adopted the ET Project as one of their community service projects. Master Gardener staff person Dee Emory is coordinating the study and the efforts of Master Gardener volunteers working on the project. Dee will be coordinating training for the Master Gardener Speakers Bureau. The Speakers Bureau will also be available to address the concerns of the homeowners assigned to them.

Texas A&M University: Experts in turfgrass and irrigation are being consulted on a regular basis for the design and implementation of the ET Project. The ET Home Page on the World Wide Web which is maintained by Dr. Guy Fipps is our primary source of ET data. You may wish to visit this site to learn more about how ET data is used in other parts of Texas. The site address is: http://agen.tamu.edu/projects/pet/sant.

San Antonio Water System (SAWS): SAWS has provided materials and funding necessary to conduct the pilot, present and upcoming projects. In addition, the weather station used for San Antonio ET calculations is located at the Jones-Maltsberger SAWS Pumping Station.

ET Protocol: Refill Once a Week

We are studying three different water replacement rates in order to discover which one works best for homeowners. We hope to match replacement rates to homeowner acceptance levels for lawn appearance during summer months.

Summary: Homeowners will water their lawns on the same day each week. Each day we will add up how much water is removed from the soil. At the end of the week, we will have a total amount in inches that they will need to add to their soil in order to refill the soil reservoir. This method should result in water saving because participants will apply no more than is necessary to refill. We will track rainfall during the week and subtract any rainfall from the refill amount. During an extremely hot and dry week, the refill amount may be up to one inch. However, during a cloudy or rainy week, the refill amount may be only ¼".

Important Tasks For Participants:

1. Participants will have to be very familiar with their sprinkler application rate and know how long it will take to apply water in ¼" increments. Those with automatic systems will have to adjust their timer to make the system only run for as long as it is necessary to apply the refill amount.

2. Rating of lawns must be done on Sunday morning. This will give us feedback on whether your lawn is responding well to this schedule.

Why This Method? We believe this method of using ET data will be easy for homeowners. It only requires attention to ET rates on one weekday and there is only one watering day. However, it will be important that we obtain feedback on the quality of lawns on this protocol.

100% During the 1999 ET Study we found that St. Augustine and zoysia lawns (in sun and in shade) where homeowners replaced 100% of ET, a good appearance was maintained. They had only a slight decline in quality during July and early August.

75% Homeowners replacing 70% of total ET during the 1999 ET Study had their lawn ratings drop by 1 to 2 levels during July and early August; however, the lawns quickly recovered their quality appearance in the fall when weather conditions improved.

50% Homeowners replacing 50% of total ET in the 1999 Study had lawns showing stress, however, none went dormant and all lawns returned to favorable ratings when weather conditions improved.

Directions for Participants
In the Bexar County ET Study

We are hoping to discover the best way to utilize ET data for home lawn care. Because this technology has been applied to turfgrass in this area, we are pioneers and will need to learn as the study progresses. This protocol is our starting point. The directions we ask you to follow may change as you provide us with feedback.

Daily Tasks:

1. Note any measurable rainfall on your data sheet.

2. Note any lawn efforts you make such as mowing or fertilization.

Every Sunday:

1. Call the ET Phone Line to get the total ET for the past week. The recording will tell you how many inches to apply if you are on a 100% replacement rate, on a 70% replacement rate or on a 50% replacement rate.

2. Rate your lawn before 10:00 a.m.

3. Record your ratings and observations on your data sheet.

Watering:

1. Water your lawn with amount instructed on the ET Phone Line either on Sunday evening (after 8:00 p.m.) or on Tuesday morning (before 10:00 a.m.).

2. Carefully time your watering so that you can apply only the amount instructed on the ET Phone Line.

3. Note any deviation from watering instructions on your data sheet.

4. If the total water you would apply at your replacement rate adds up to less than ½", the instructions will be to wait one week before watering. If rainfall has refilled the soil reservoirs, the recording will instruct you to delay watering.

Communicating Your Data: We will need to see your data sheets every two weeks. Your monitor will pick up your data every two weeks.

Communicating Problems: *PLEASE CALL YOUR MONITOR IF THERE IS A PROBLEM WITH YOUR LAWN OR IF YOU NEED CLARIFICATION ON INSTRUCTIONS.* If for some reason you find you are unable to follow the instructions or your lawn is responding very poorly, we need to know immediately. Call Dee Emory at 467-6575. She will be checking her messages daily.

Bexar County Master Gardener
ET Program — Data Form

Name:
Address
City, State, Zip:
Rate:
Turf Type:
Quadrant:

E-mail address for ET Program: evapo_t@texas.net

DATE					Mail In Data Sheet
LAWN RATING					

System for rating lawn: 1—Excellent: 2—Good; 3—Fair; 4—Poor

Other Information: (Include any evidence of disease, herbicide use or accidental deviation from watering instructions:

ET PROJECT DATA COLLECTION FORM

Lawn Number	Quadrant	Protocol	Turf Variety	Mower Height	Soil Depth	Soil Type
Name			Address			
Date						
Lawn Rating						

ADDITIONAL INFORMATION

Date	Rainfall (Inches)	Fertilizer Application	Herbicide Application	Found Disease Damage	Found Insect Damage	Mowing

Notes: Include information on type of fertilizer or herbicide used; name of insect or disease found; type of mechanical change (change on sprinkler system, aeration, changing size of lawn, etc.) or if watered at different than the protocol rate.

Lawn ratings: **Excellent = 4** **Good = 3** **Fair = 2** **Poor = 1** **Rate lawn prior to watering**

ET MONITOR DATA COLLECTION

Lawn No.	Quadrant	Protocol	Turf Variety	Month	Monitor Name

Name	Address

Date	Meter Reading	Lawn Rating		Date	Meter Reading	Lawn Rating
1				17		
2				18		
3				19		
4				20		
5				21		
6				22		
7				23		
8				24		
9				25		
10				26		
11				27		
12				28		
13				29		
14				30		
15				31		
16						

Notes:

Lawn rating: Excellent = 4 Good = 3 Fair = 2 Poor = 1 Rate lawn prior to watering

Purposes and Responsibilities of the ET Study Monitor

The monitors are some of the most important people in the pilot study. Each monitor will also serve as the initial contact person for the homeowner. If there are any problems or questions, the homeowner will attempt to contact their monitor first. Then the monitor and other members of the ET project team will work to find a solution to the problem.

The responsibilities of the monitor are as follows:

1. The monitor will act as the key contact person for everyone assigned to him/her. As part of keeping up communications, the monitor will be asked to:

    a. Call participants on their assignment list with information on protocol changes.

    b. Receive feedback from participants which will be passed on to the ET Coordinator.

    c. Pay close attention to the quality of each assigned lawn and how each homeowner feels about his/her lawn quality. If the satisfaction level of a participant is low, we will need to hear about it from the monitor in order to make adjustments.

2. Make regular site visits to assigned lawns.

    a. Visit twice per month to check quality.

    b. Visit in response to homeowner questions.

    c. Pick up data sheets from participants.

3. Evaluate data records being maintained by homeowner.

4. Spot check accuracy following protocol.

Start Dates

*Inform homeowners to saturate lawns on Monday, June 7 (at least 1 inch of water).

*Begin monitoring on Saturday, June 12

HOW TO OBTAIN ET DATA

We have set up an "ET Phone Line" for your convenience. Each day the message on the phone line will be updated for you.

The ET Phone Line Number is:

(210) 281-1478

Call the ET Phone Line every Sunday. A pre-recorded message will have the information that you need.

If you are unable to access the Bexar County Master Gardener ET hotline, call the Bexar County Master Gardener Office or the Bexar County Extension Office at (210) 467-6575 and ask to speak with a member of the ET Project Team.

Questions on the ET Study and Who to Call

1. **Try to reach your monitor.** You have been assigned a monitor in your area. This monitor will be familiar with your lawn because he/she will be making site visits regularly to see how your grass is responding to the protocol. Please try to reach this person first with any questions. You can find his/her phone number on our participants list.

2. **Call ET Coordinator Dee Emory at 467-6575.** Dee is responsible for coordinating the ET Study under the direction of the Texas Agricultural Extension Service. She can be reached during the week.

3. **Call the Texas Agricultural Extension Service at 467-6575.** Two staff members (Joe Taylor and Edna Ortiz) at the Texas Agricultural Extension Service are collaborating on the ET Project.

How to Determine Your Sprinkler Application Rate

We cannot tell you any average numbers for the output of sprinkler systems, because there are none. Each station of an individual sprinkler system varies tremendously in output. And, different locations and sprinkler equipment cause vastly different amounts of water to be applied in the same time period. For this reason, it is imperative that you conduct your own test to determine your sprinkler application rate.

Equipment Needed:

Three straight-sided containers, such as cake pants or tuna cans
A ruler
A watch or timer

Steps to Follow:

1. Place out your pans in the area where you will evaluating your grass. Space the pans apart several feet from each other in a triangular pattern.

2. Turn on your sprinkler system for 15 minutes.

3. Measure the depth of the water in each pan.

4. Add the water you measured in each pan and divide by three to obtain the average depth.

5. You now know for that area of your lawn, the application rate for a fifteen-minute period.

6. To determine the sprinkler application rate for one hour, multiply by four.

**We will only ask you to apply water in increments of ¼-inch of water. If you find out how long it takes to apply ¼-inch of water, it will be easy for you to follow the instructions.

"DON'T BAG IT" LAWN CARE PROGRAM

Calvin F. Finch, Ph.D
County Extension Agent-Horticulture
Texas Agricultural Extension Service

Joe Taylor
County Extension Agent-Agriculture
Texas Agricultural Extension Service

Fertilizing Plan

The rate of fertilizer application, the frequency of application, the ratio of nutrients in the fertilizer and the source of the nitrogen all have a great deal to do with how fast the lawn grows.

The following fertilizing plan is designed to allow the lawn to grow at a reasonable rate and still have a good color.

Fertilizer Ratio (NPK)	Fertilizer Analysis	Application rate - Pounds per 1000 sq. ft.
3-1-2*	12-4-8	8
	15-5-10	7
	21-7-14	5
4-1-2	16-4-8	6
	20-5-10	5
	19-5-9	5
Other	27-3-3	4

For slow, even growth, use a fertilizer containing either sulfur-coated urea or ureaformaldehyde as a nitrogen source, rather than soluble forms, for the spring. The soluble forms, such as urea or ammonium sulfate, tend to produce very fast growth for short periods of time. Organize fertilizers are also good sources of slow release fertilizer.

Organic	9-1-1	11
	7-2-2	14

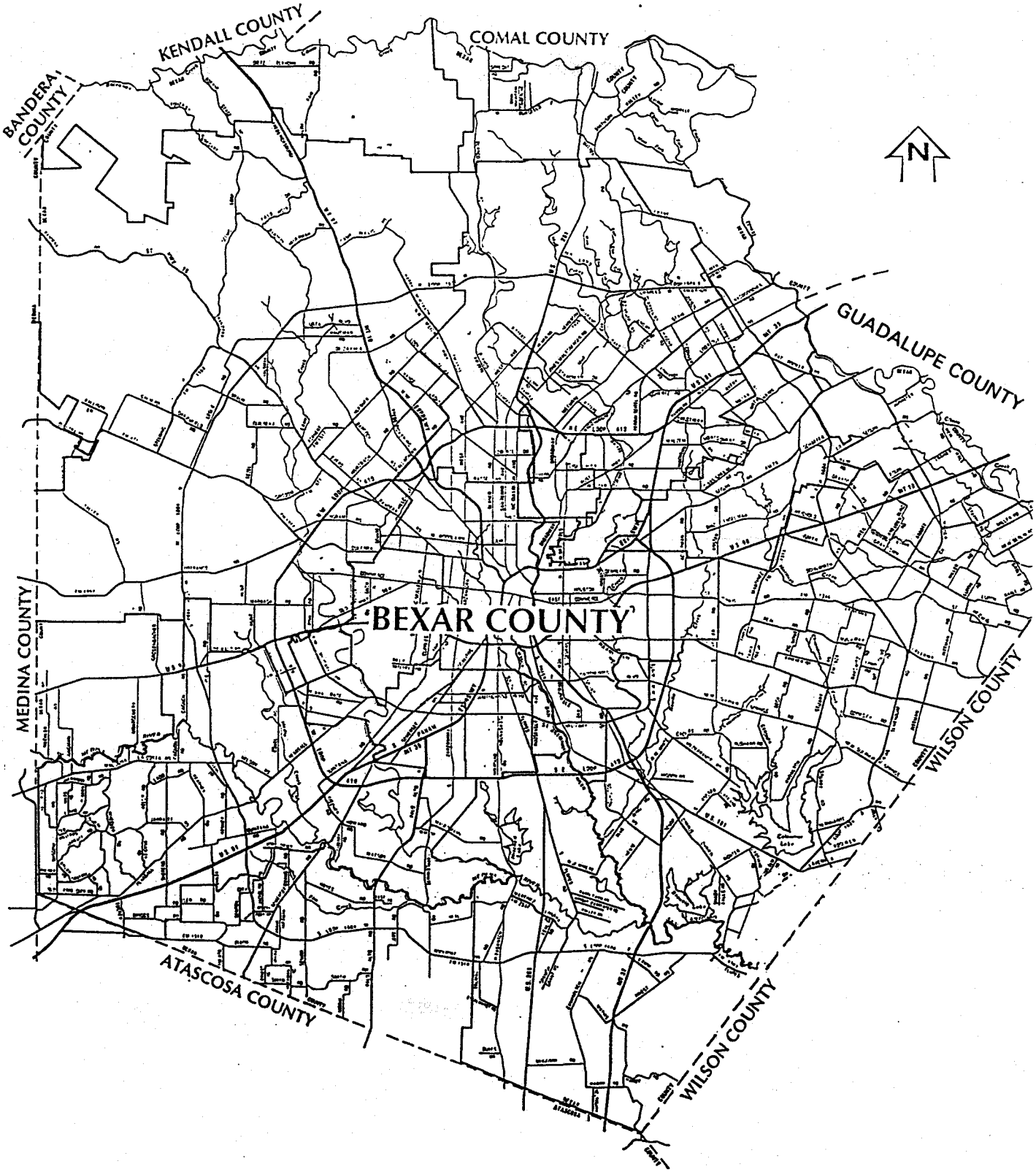
Yellowing is often caused by iron deficiency in our alkaline soil. A Fe-Iron Treatment may be necessary to improve green color of grass.

Watering Plan

Grass varieties and their need for water:

1. St. Augustine (needs the most water)
2. "Tif" Bermuda
3. Zoysia
4. Common Bermuda
5. Buffalo (needs the least water)

Bexar County Map



EVAPO-TRANSPIRATION TESTING AGREEMENT

In order for the lawn demonstrator to be an eligible participant of the Evapo-Transpiration Project testing, he/she must agree to the following:

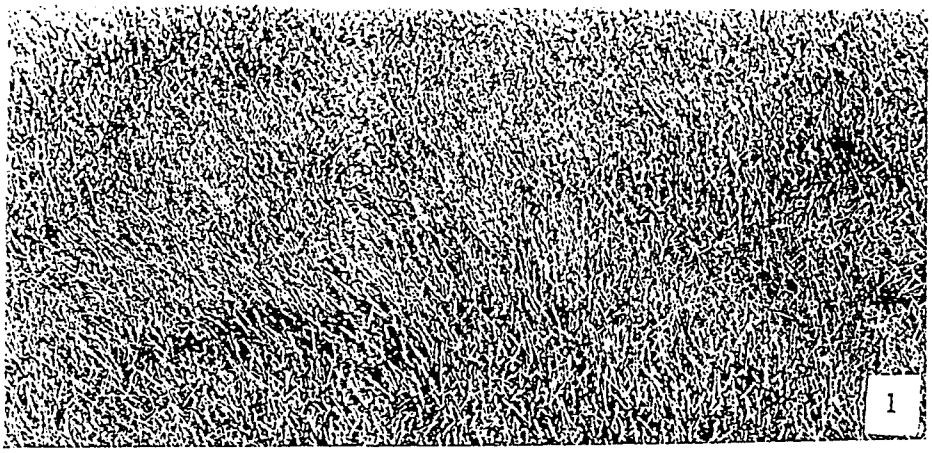
1. Test sites must have a well-established turf grass
2. Allow Master Gardener, Extension Service and other ET officials to have access to the part of your property involved in the experiment for the purposes of the experiment.
3. Attend a training session where the following will be reviewed:
    a. Watering program procedures
    b. Determine the sprinkler application rate
    c. Measure PET (Potential Evapo-Transpiration)
    d. Rate turf quality
    e. Look for signs of disease and stress on lawn.
4. Record all data on date table and monitor will pick up data every two weeks
5. Follow Texas Agricultural Extension Service recommendations for lawn care
    a. Mow at height and frequency recommended for your grass variety.
    b. Apply recommended amounts of fertilizer
    c. Lawn clippings cannot be bagged
6. Post a sign in a visible spot identifying the lawn as part of the experiment. The sign will help educate area residents to the potential of ET
7. Allow the San Antonio Water System to release to ET staff information on your water usage for two years past and during the experiment for analysis of changes in water use. No names will be published and your data will be used only as part of the statistics of the project.
8. Attend a follow-up session in the fall to offer feedback on the study.

I agree to follow the Evapo-Transpiration study guidelines as described above. As part of my participation, I will receive free lawn fertilizer, a Lawn Care/Evapo-Transpiration notebook, and will have available master Gardener and Extension Agent resources for consultation on my lawn as needed.

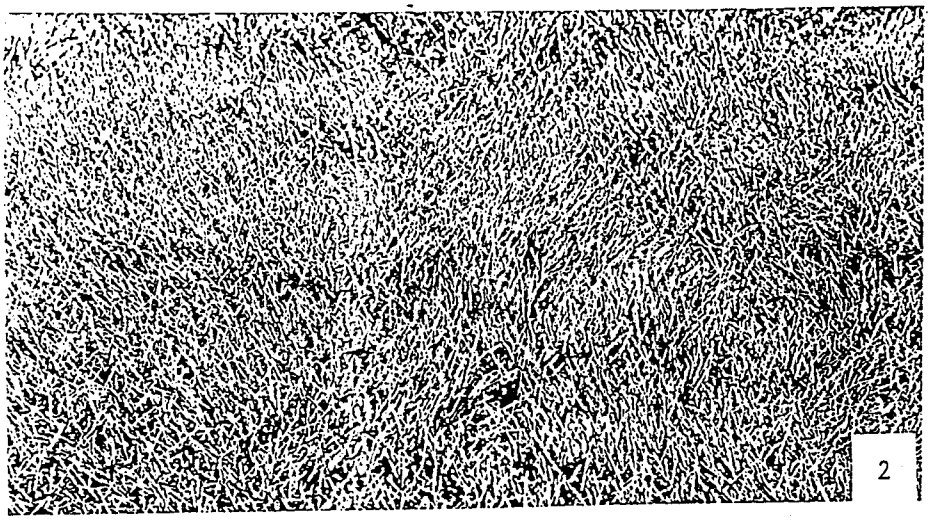
_____ _____

Lawn Demonstrator Signature Date

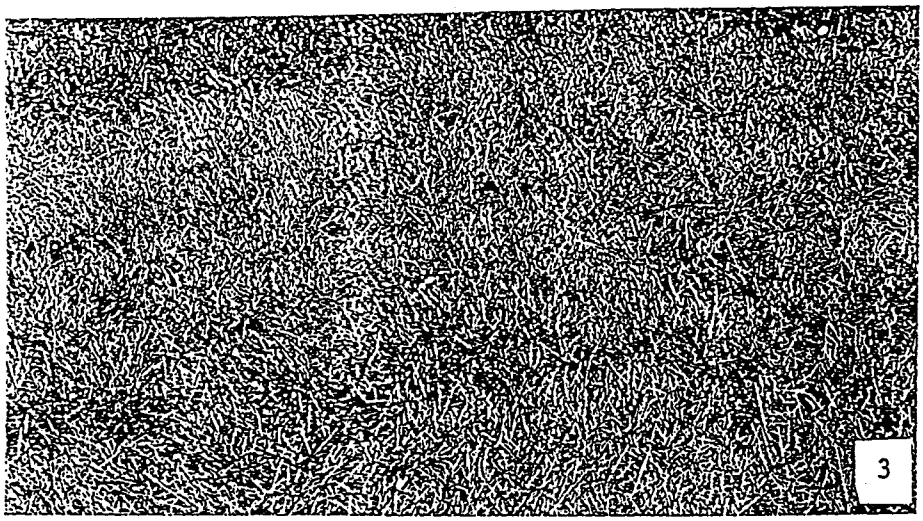
ZOYSIA



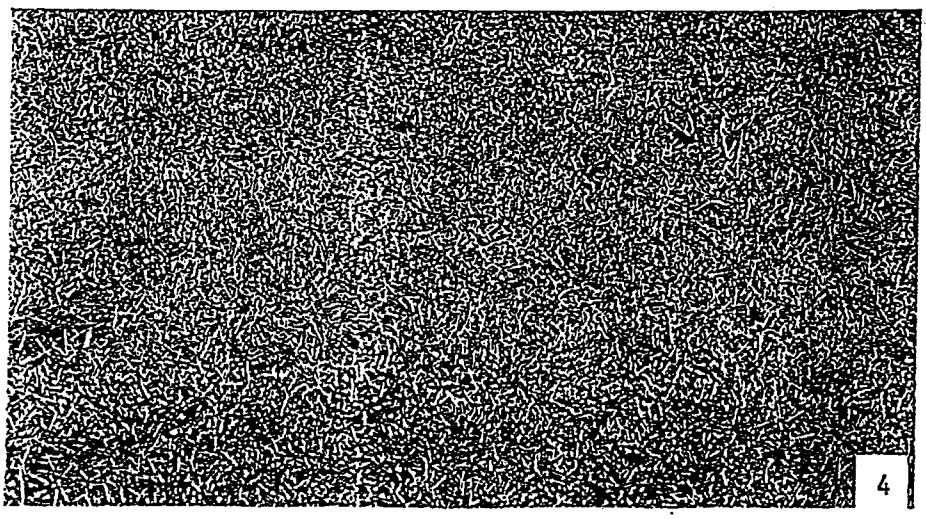
1. EXCELLENT: The turf is very dense with no ground visible when looking from above. The color is a uniform green with no yellowing. No weeds or bare spots are evident.



2. GOOD: No ground is visible when looking from above. The color is uniform green nearly throughout. There may be a few areas with color variation. Very few weeds are evident and there are no completely bare spots.

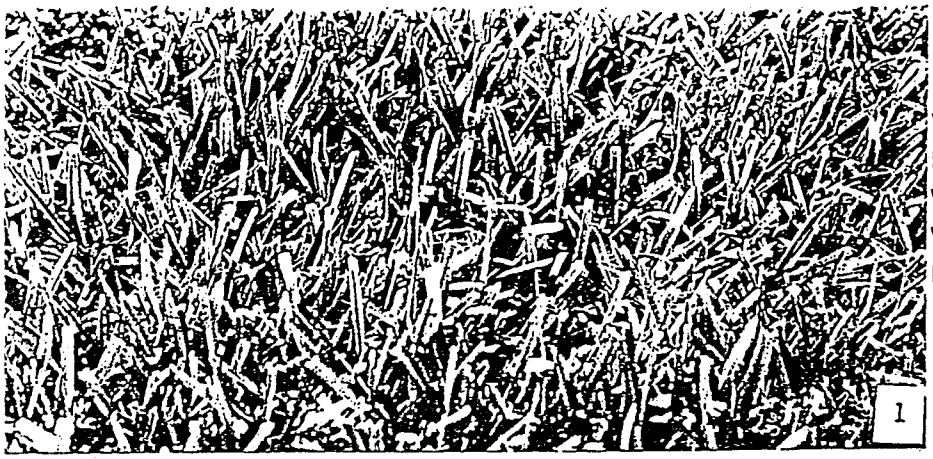


3. FAIR: There are areas in the lawn where the grass is thin enough to see soil through the stems, but most is dense enough to cover the lawn. Variations of green color and some browning are evident. Some weeds may be evident in the thin areas.

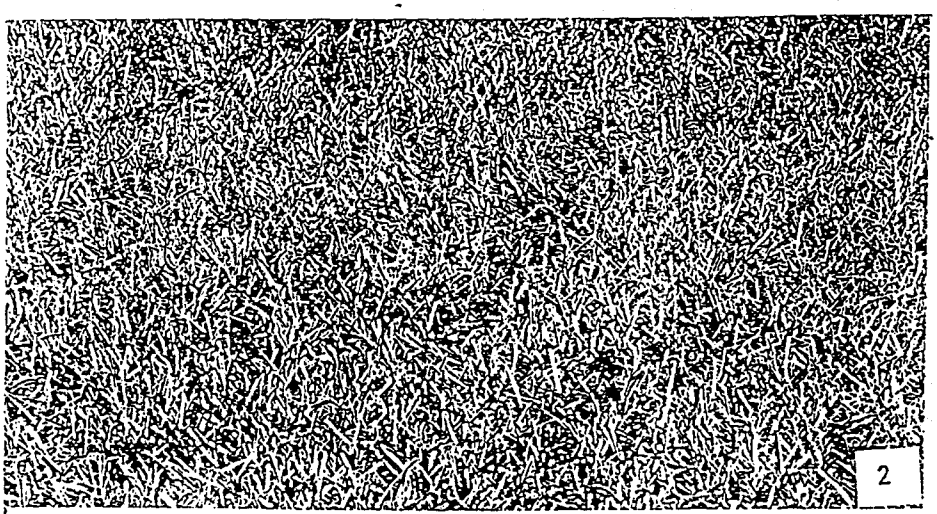


4. POOR: The lawn is not dense enough to cover the soil. There are brown patches and bare spots. Weeds have invaded the lawn and are obvious.

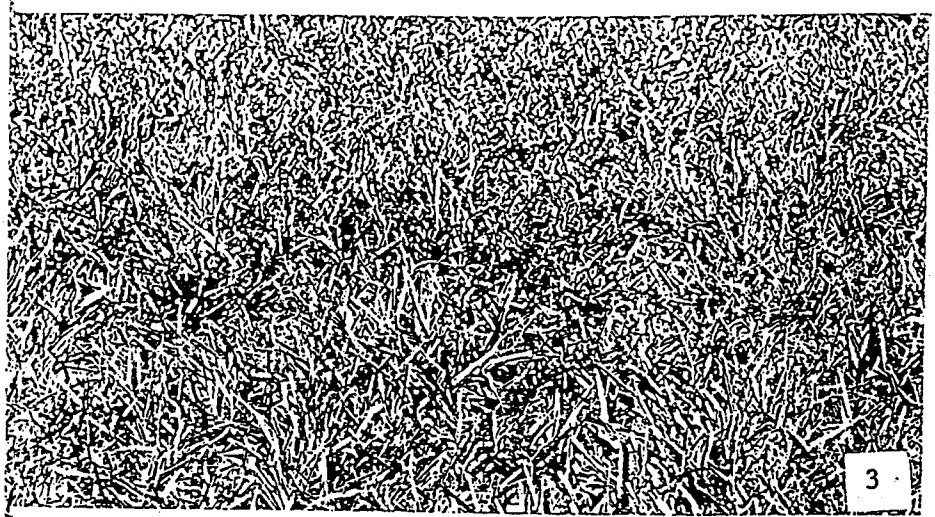
ST. AUGUSTINE



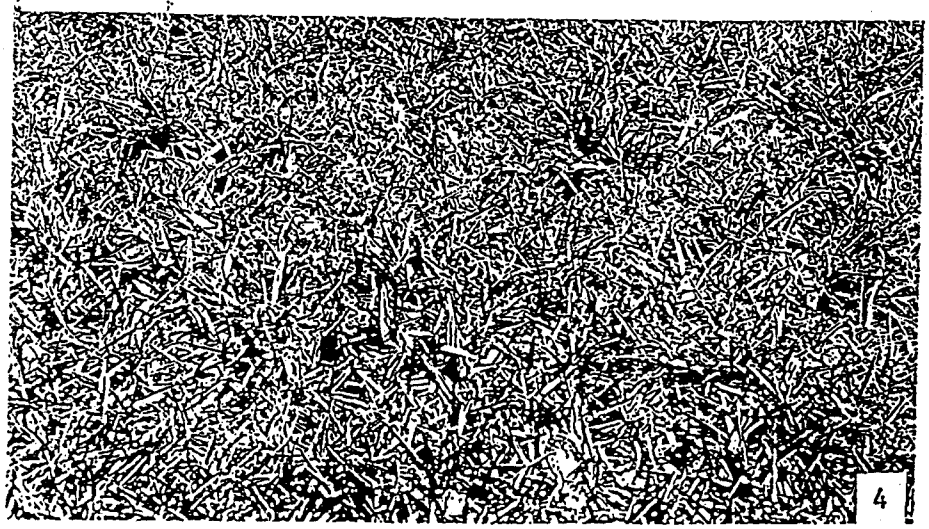
1. EXCELLENT: Density — very thick; lush green color; no yellowing; Blades flat and wide; sod springs back after walking over in the morning; no evidence of weeds.



2. GOOD: Density — No evidence of bare ground, however grass blades are not thick and close; green in color, may be mottled dark and light green areas; blades are flat but may curl in the heat of the afternoon on hot days; no evidence of weeds.



3. FAIR: Density — finding sparse, scattered bare spots; yellowing may be present; leaf blades may be curled and show browning of leaf margins; weed encroachment is evident. Grass doesn't spring back after walking over.



4. POOR: Density — finding several scattered bare spots; yellowing and off-green color is present; leaf margins are brown; disease symptoms may be present; weeds are present and represent more than 25% of turf area. Grass is stressed and does not respond or spring back after walking over.