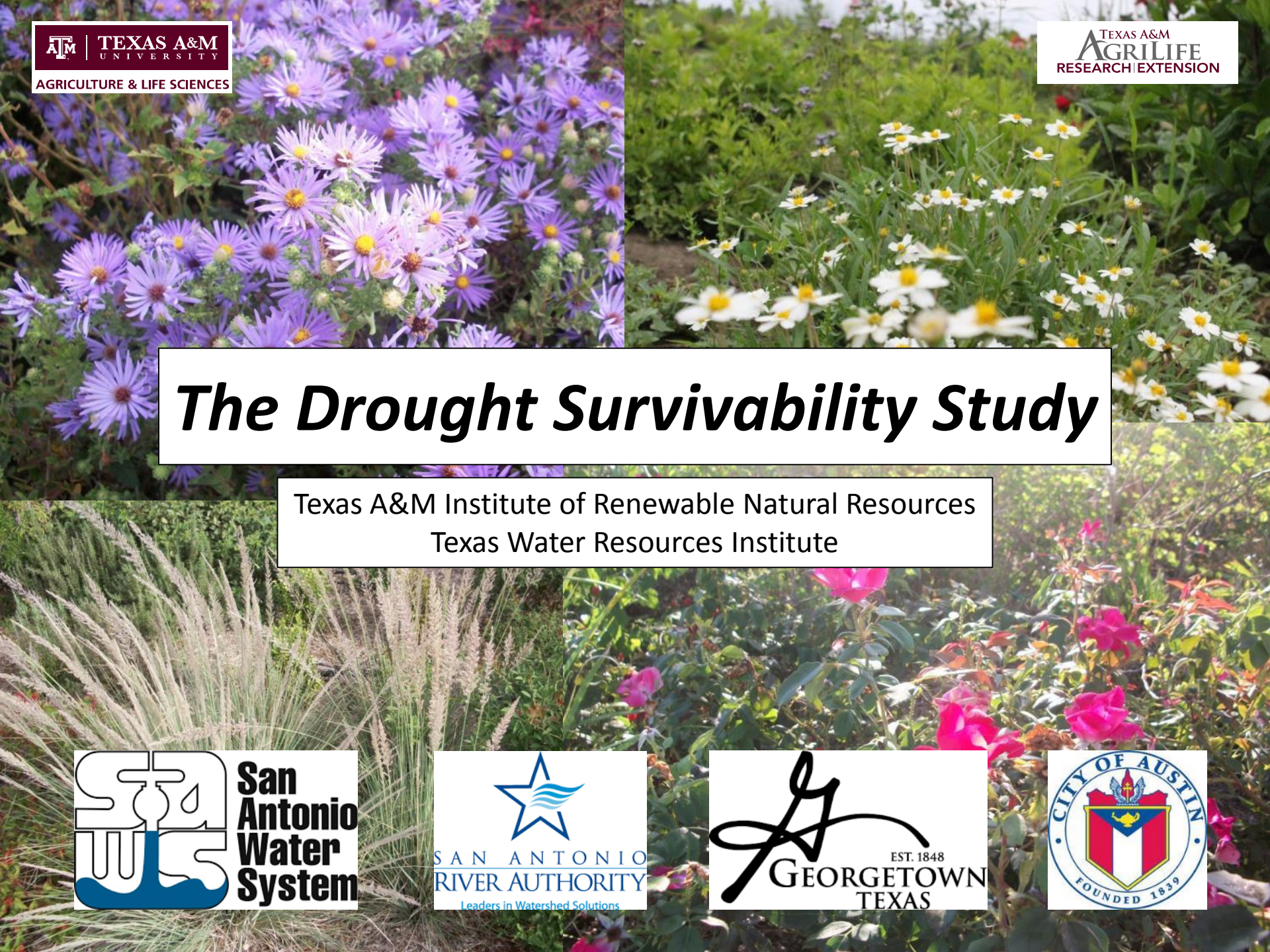
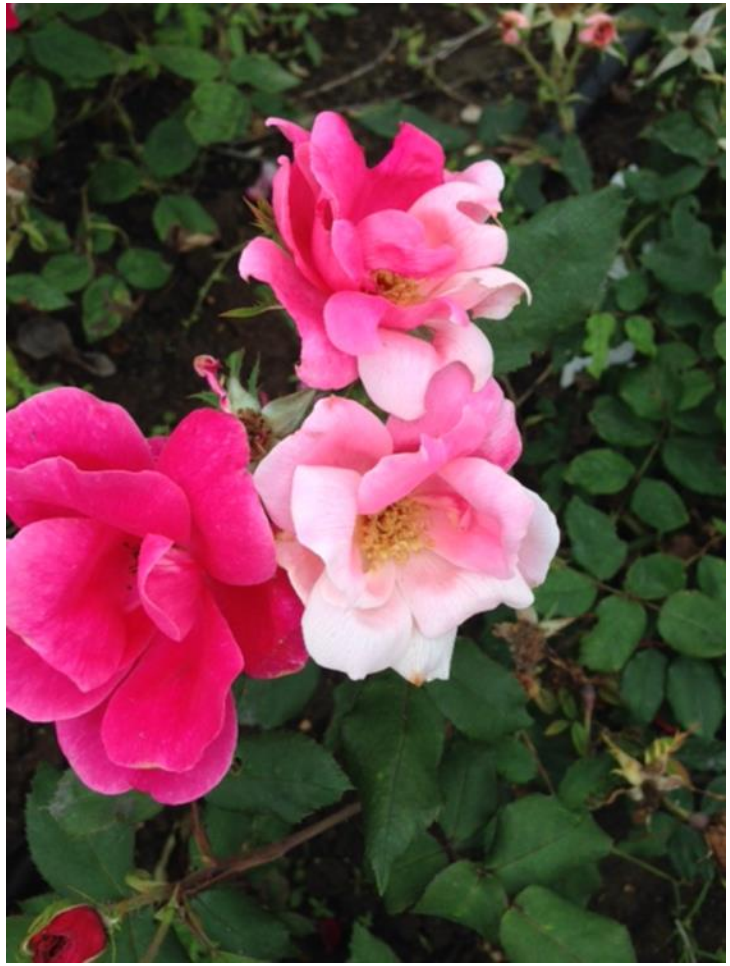


The Drought Survivability Study

Texas A&M Institute of Renewable Natural Resources
Texas Water Resources Institute

Why is landscape water use important?

- Discretionary Usage
- Data driven suggestions
- Impact of drought in central Texas
- Potential water savings in urban landscaping



Research Objective

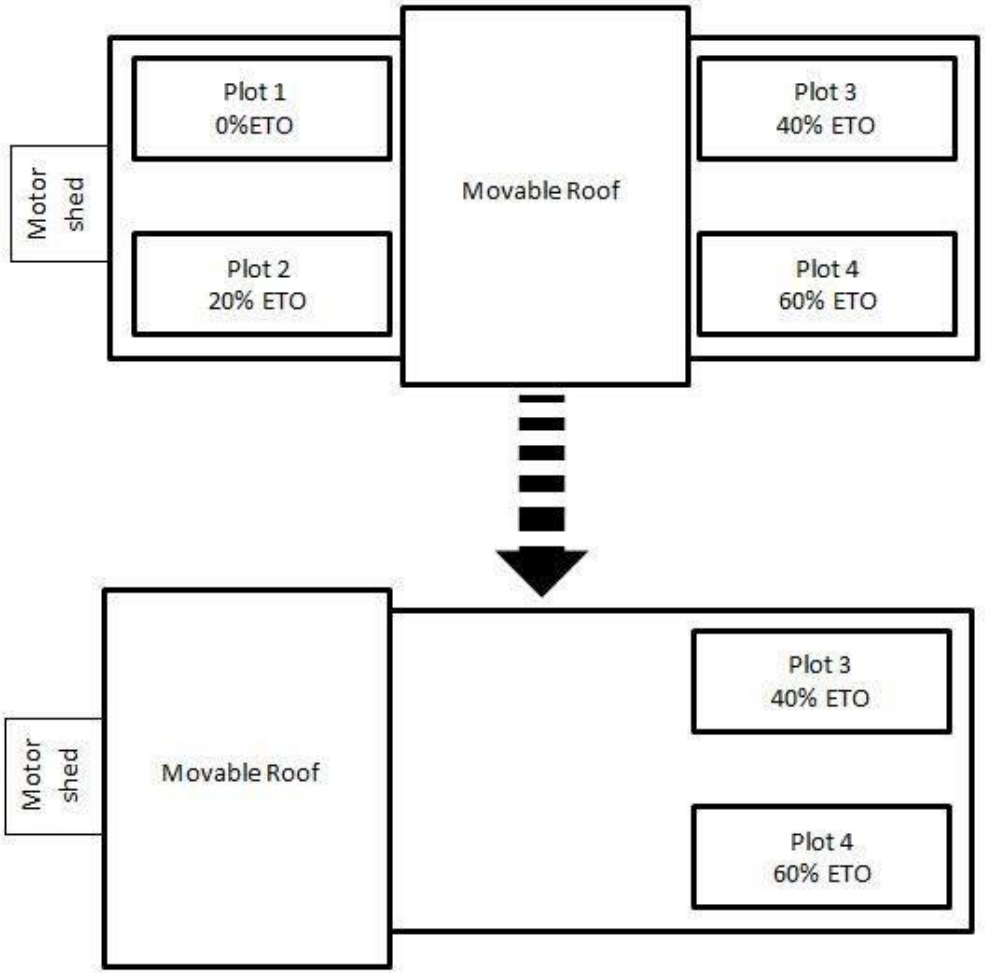
- To analyze urban landscaping for outdoor water conservation efforts for 97 ornamental plants
- Jointly funded by San Antonio Water System (SAWS), San Antonio River Authority (SARA), City of Austin, and City of Georgetown

The Study

The Drought Survivability Study (D.S.S) is a horticultural experiment conducted by the Texas A&M Institute for Renewable Natural Resources that tested the drought tolerances of 97 ornamental species under 4 different irrigation regimes.

Each of the 4 experimental plots contained 97 ornamental plant species and was irrigated at a different percentage of Potential Evapotranspiration (ETO) as follows: 0% ETO, 20% ETO, 40% ETO, and 60% ETO.

Plots 1 and 2, with the lowest irrigation were covered by a movable roof when it rained.



The Drought Simulator is located on the South Side of San Antonio, Texas, and owned by San Antonio Water Systems.

Evapotranspiration

- **Evapotranspiration –** The water a plant loses through evaporation and transpiration.
- **Potential Evapotranspiration (ETo)**- an estimate of evapotranspiration calculated using the Penman-Montieth equation, and climactic data such as temperature, dew point, wind speed, and solar radiation.
- All historic and current ETO values were obtained from the Texas ET network, available at http://texaset.tamu.edu/pet.php.

Table 1. Historical Monthly Evapotransipiration Averages in inches for Austin and San Antonio, Texas

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Austin	2.27	2.72	4.34	5.27	6.39	7.15	7.22	7.25	5.57	4.38	2.74	2.21	57.51
San Antonio	2.42	2.9	4.42	5.47	6.47	6.97	7.31	6.99	5.64	4.44	2.85	2.36	58.24

Evapotranspiration

After a four month establishment period during which all plots were irrigated at 100% ETo.

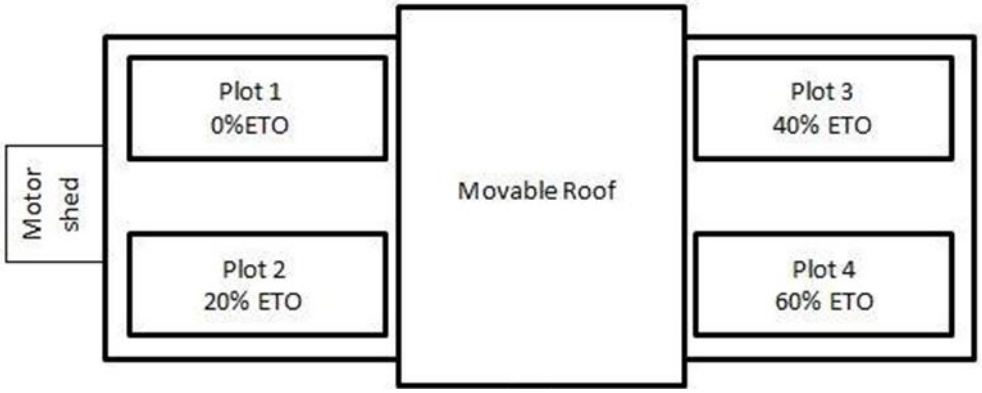
Each of the four plots were irrigated at a different percentage of total ETo for that month: 0%, 20%, 40%, and 60%

Table 1. Historical Mo ly Evapotransipiration Averages in inches for Austin d San Antonio, Texas

City	Jan	Fe	Mar	Apr	May	Jun	Jul	Aug	Sep		Nov	Dec	Total
Austin	2.27	2.72	4.34	5.27	6.39	7.15	7.22	7.25	5.57	4.38	2.74	2.21	57.51
San Antonio	2.42	2.9	4.42	5.47	6.47	6.97	7.31	6.99	5.64	4.44	2.85	2.36	58.24

Irrigation at the Drought Survivability Study

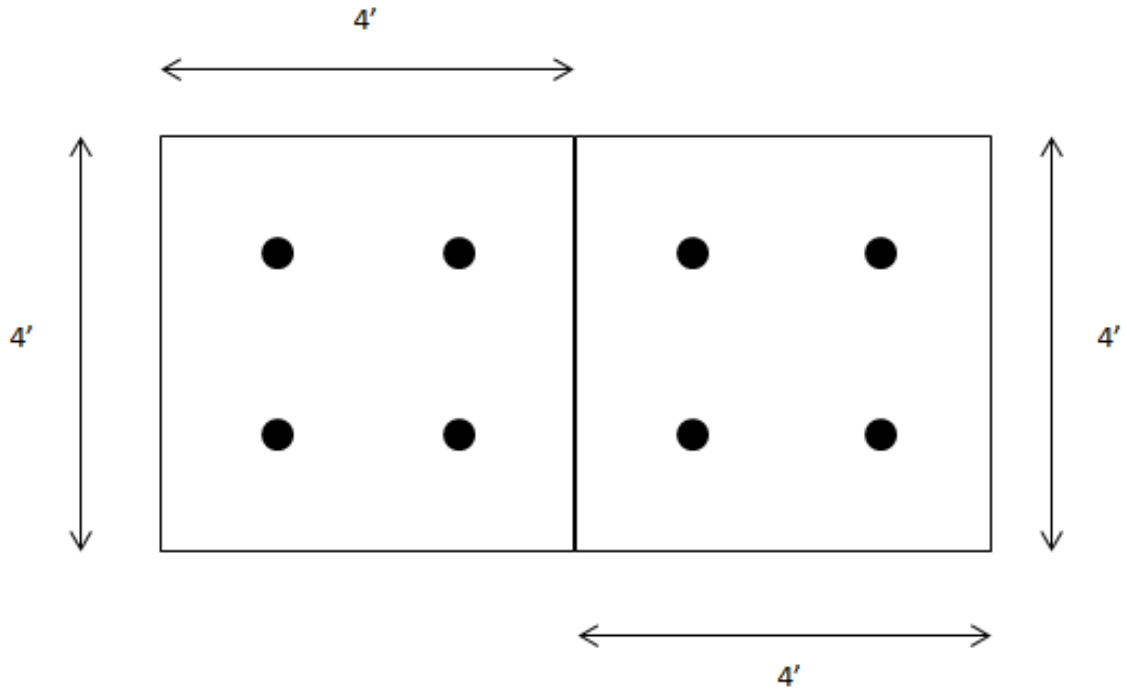
From Mid-July to September each plot was irrigated at a different percentage of ETo



Individual plants received the following irrigation for 12 weeks:

- Plot 1 plants= 0 gallons
- Plot 2 plants≈9 gallons
- Plot 3 plants≈17 gallons
- Plot 4 plants≈25 gallons

DIAGRAM SHOWING SAME SPECIES PLANTED IN THE 4' x 4' BLOCKS



BLOCK 1

4 ONE GAL PLANTS OF SAME SPECIES

BLOCK 2

4 ONE GAL PLANTS OF SAME SPECIES

Methods

- 97 Ornamental plants chosen using four horticultural and nursery lists from Texas
  - Perennials, Grasses, Shrubs, and Trees
- Establishment Period – February to May 2016
- Three planting days, three weeding days, twelve data collection weeks with volunteers
- Data collection period (Phase I) July to September 2015; (Phase II) December to March 2016

Methods Continued

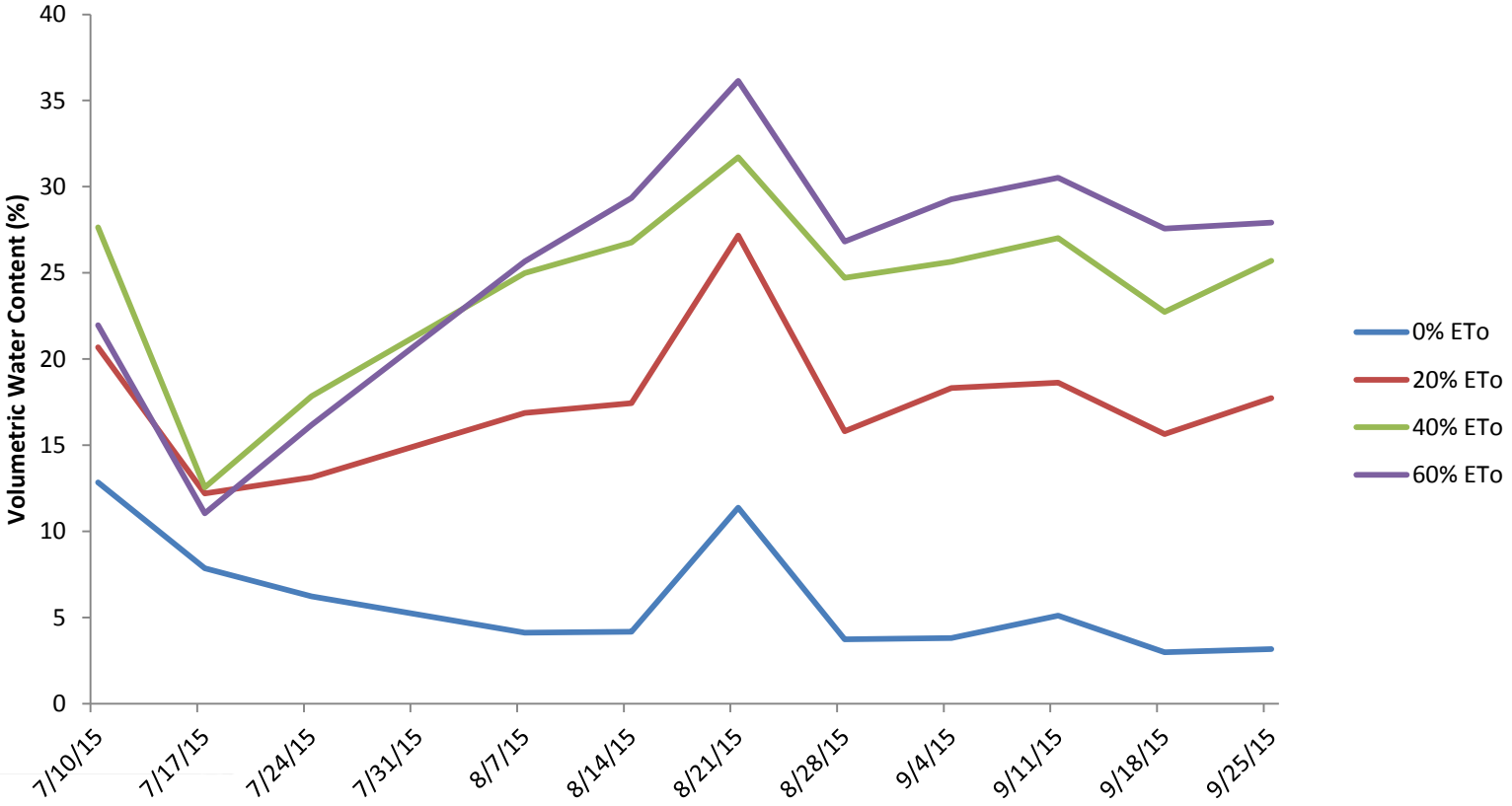
- Phase I
  - Volunteers collect data over 12 data weeks
  - Four months of drought treatment: 0%, 20%, 40%, 60% ETo
- Phase II
  - Volunteers collect data once every month for four months
  - Four months of no additional irrigation; natural rainfall only

What are we collecting?

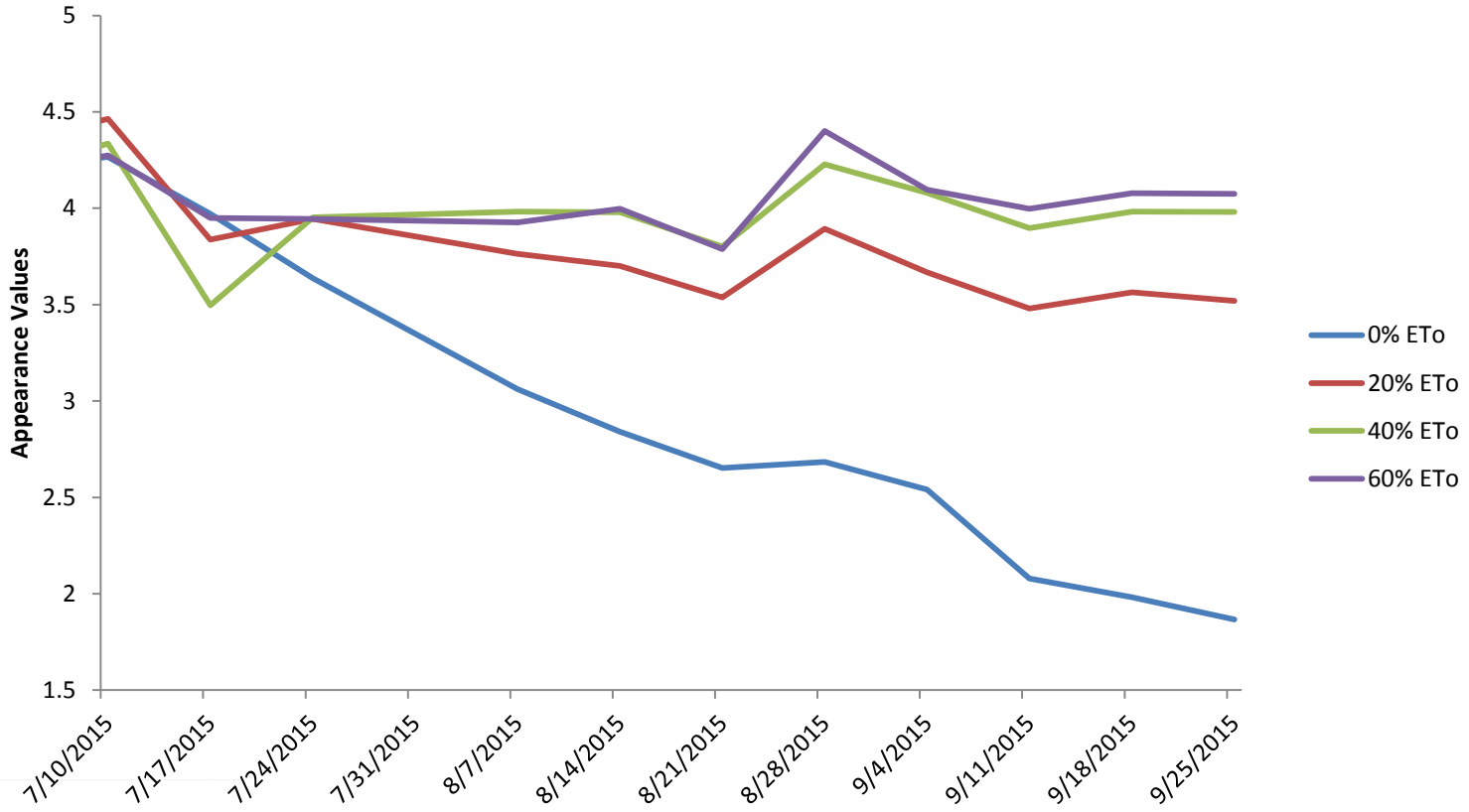
- Appearance monitoring
  - Lush, Stable, Wilt, Leaf Drop, Defoliated, Dead
- Soil Moisture Data
- Infrared Thermometer Data
  - Foliar temperature can indicate stress

Results

Phase I: Soil Moisture Over Time



Phase I: Appearance Ratings Over Time



How to analyze 1,576 plants…?

Highest Performance (25% Quartile)

Moderate Performance (50% Quartile)

Lower Performance (75% Quartile)

Lowest Performance (100% Quartile)

Plant Performance Index (PPI)

0.0 ETo		0.2 ETo		0.4 ETo		0.6 ETo		ALL	
Cenizo	125	Esperanza	144	Boxwood	144	Boxwood	144	Confetti Lantana	564
Chile Pequin	11[illegible]	Flowering Senna	144	Guara	144	Confetti Lantana	144	Gaura	558
Mistflower	102	Knock Out Rose	137	Esperanza	140	Red Yucca	141	Little Bluestem	510
Indian Grass	99	Oleander	137	Indian Grass	140	Santolina	141	Mystic Spires Salvia	510
Mexican Honeysuckle	48	Moy Grande Hibiscus	115	Blue Grama Grass	127	Asiatic Jasmine	130	Crepe Myrtle	420
Society Garlic	43	Anacacho Orchid	108	Rosemary	126	Gulf Muhly	12[illegible]	Moy Grande Hibiscus	417
Thyrallis	42	Bulbine	106	Zexmania	126	Indian Grass	129	Compact Nandina	411
Blue Liriope	28	Blue Liriope	72	Gregg Salvia	98	Texas Mountain Laurel	105	Fall [illegible]edient Plant	311
Asiatic Jasmine	26	Primrose Jasmine	70	Texas Mountain Laurel	95	Jerusalem Sage	102	Grandmas Yellow Rose	301
Coral Honeysuckle	2[illegible]	Milkweed	69	Fall Obedient Plant	92	Viburnum Tinus	101	Agarita	292
American Beautyberry	24	Dutch Iris	66	Agarita	89	Cemetary Iris	91	Bat Faced Cuphea	283
Glossy Abelia	24	Sago Palm	64	Possumhaw Holly	84	Gregg Salvia	91	Mexican Mint Marigold	268
Yaupon Holly	22	Mexican Mint Marigold	49	Monkey Grass	71	Glossy Abelia	75	Society Garlic	217
Buford Holly	20	Monkey Grass	42	Mexican Mint Marigold	69	Moy Grande Hibiscus	74	Viburnum Tinus	207
Nolina	12	Viburnum Tinus	38	Mexican Oregano	58	Nolina	58	Glossy Abelia	191
Purple Coneflower	12	Bat Faced Cuphea	34	Dwarf Chinese Holly	49	Dwarf Nandina	56	Prostrate Rosemary	176
Dwarf Chinese Holly	7	Purple Coneflower	24	Blue Princess Verbena	35	Blue Liriope	43	Dwarf Nandina	116
Carolina Jessamine Vine	6	Yellow Columbine	24	Dwarf Nandina	33	Pittosporum	33	Mexican Oregano	106
Cemetary Iris	3	Mexican Oregano	20	Pittosporum	33	Purple Coneflower	30	Purple Coneflower	105

Comparative Water Use

(0% ETo) = Zero Irrigation

(20% ETo) = 10-13 min of irrigation

(40% ETo) = 23-25 min of irrigation

(60% ETo) = 37-40 min of irrigation

40% ETo = 60% ETo (in overall appearances); 14-15 min irrigation reduction

Potential of 8 gallons of savings per plant

0% ETO

20% ETO

40% ETO

60% ETO

Turks Cap

0% ETO

20% ETO

40% ETO

60% ETO

Rock Rose

0% ETO

20% ETO

40% ETO

60% ETO

Purple Fountain Grass

0% ETO

20% ETO

40% ETO

60% ETO

Gulf Muhly

0% ETO

20% ETO

40% ETO

60% ETO

Red Yucca

0% ETO

20% ETO

40% ETO

60% ETO

Pride of Barbados

0% ETO

20% ETO

40% ETO

60% ETO

Oleander

0% ETO

20% ETO

40% ETO

60% ETO

Cenizo

0% ETO

20% ETO

40% ETO

60% ETO

Texas Sotol

0% ETO

20% ETO

40% ETO

60% ETO

Flowering Senna

0% ETO

20% ETO

40% ETO

60% ETO

Chile Pequin

0% ETO

20% ETO

40% ETO

60% ETO

Sago Palm

0% ETO

20% ETO

40% ETO

60% ETO

Thyrallis

0% ETO

20% ETO

40% ETO

60% ETO

Agarita

0% ETO

20% ETO

40% ETO

60% ETO

Milkweed

0% ETO

20% ETO

40% ETO

60% ETO

Knock Out Rose

0% ETO

20% ETO

40% ETO

60% ETO

Fall Aster

0% ETO

20% ETO

40% ETO

60% ETO

Esperanza

0% ETO

20% ETO

40% ETO

60% ETO

TEXAS A&M IRNR
Institute of Renewable Natural Resources

Asiatic Jasmine

0% ETO

20% ETO

40% ETO

60% ETO

Bat-faced Cuphea

0% ETO

20% ETO

40% ETO

60% ETO

Phase II – Plants that recovered

- Four month recovery period
  - No irrigation to any plot, only natural rainfall
- 25 plants recovered in appearances
  - Agarita, Boxwood, Dutch Iris, Four Nerve Daisy, Jerusalem Sage, Mutabilis Rose, Thyrallis, and etc.
- 10 plants declined in appearances

Discussion

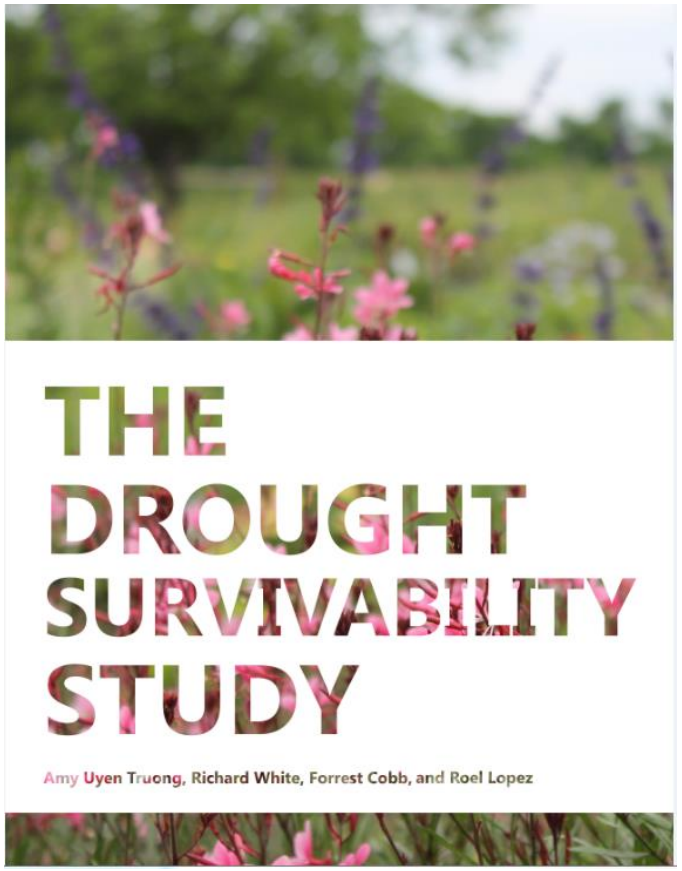
- 40% ETo and 60% ETo plots have no statistical difference between overall plant appearance
- 21% of plants were stable in the 0% ETo irrigation plot and 54% of plants were stable or lush with 20% ETo irrigation plot
- Correlation between Soil Moisture and Appearance
- Plant Performance Index comparing plants by drought survivability

Implications

- Potential of 8 gallons of savings per plant with mindful watering between the 40% ETo to 60% ETo irrigation plots.
- Selection of plants that could recover after a drought period with no additional water
- Efficient irrigation management and plant selection can help save money on water bills and re-planting plants

"The Drought Survivability Study"

http://twri.tamu.edu/publications/reports/2016/tr-495/



Thank you!

Questions?

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